ENGINEERING
TOMORROW

User manual

The performance of your rooftop system **will be at its best with MCX controllers**

3 PID loops to better achieve a stable temperature control

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1.0 Introduction

The algorithm is aimed at controlling the main types of rooftop.

It can run on the entire line of MCX systems and and is designed for the possible future use of a remote MMI interface, Modbus communication and eventually EXC06 expansion.

It can handle the following main functions:

- management of up to four compressors on two circuits.
  Up to three unloading steps per compressor
- heating with:
  - reverse flow chiller and support for electrical heaters or water valve
  - electrical heaters
  - water valve

- control of heating and cooling using PID logic
- control of fans according to air pressure using PID logic
- humidity control
- air quality control
- free cooling and free heating
- dual coil, crossed flow and rotating energy recovery
- limiting of supply temperature and humidity
- management of ON/OFF, 3-point, 0/10 V valves
- management of ON/OFF, 3-point, 0/10 V dampers
- management of alarms and history of alarms
- dynamic configuration of inputs and outputs

The type of rooftop to be controlled is defined by configuring the parameters and defining the inputs and outputs to be used to control the various elements that make up the rooftop.

Both the parameters and the inputs and outputs can be configured from a PC using the MCXShape configuration tool and the "*mcxs configuration*" file supplied with the algorithm,
(see "MCXShape user manual"), or from the instrument user interface if the dynamic configuration of inputs and outputs is enabled.

2.0 User interface

2.1 Turning the unit ON and OFF

The instrument can be switched from OFF to ON and vice versa in the following ways:

- pressing and holding the key for 3 seconds
- by parameter "C*y01*" (group "*General/Setup*")
- from menu "SEM-Set Mode/SON-Unit ON", (see 2.3.1 "Set mode")
- using the digital "*ONF - ON/OFF*" input, if present

Note

If, during the input configuration phase you set "Polarity"=N.C., the unit is OFF when the input is open.

All the above ways can turn the unit OFF. To turn it ON the digital input must allow it.
After power up the unit reverts to its previous status. The status at first power up (after auploading the application software) is defined by the default value of "*y01*" parameter.

The machine OFF mode is indicated with OFF on the main screen or "*IOF*" if the "ON/OFF" digital input is active.

2.2 Main screen

From the main screen, press and hold the key to access the menu, (see 2.3 "Menu-based navigation").

The main screen varies depending on whether an LED or LCD display is being used.

In both cases using "*dSA*" and "*dSB*" parameters, you can choose which setpoint and probe reading values are shown on displays A and B; for the list of available probes, (see 3.1 "Input and output configuration"). By default, the return probe and temperature setpoint values are used.
With the "*dSU*" parameter you set the unit of measurement shown on the display.

The choices are: none, °C, %, bar.

With the "*dSC*" parameter you can toggle between ice and sun icons for winter and summer.

2.2.1 LED display

LED display on MCX06C and MCX06D

Note

The LED display management must be enabled from the "Functionalities" tab of the MCXShape configuration tool. Tick the "Enable LED support" check box.

Fig 1 [User interface - LED display]

The meaning of the icons is indicated in the figure.
The icon is associated with the request for activation/deactivation for that function.

LED display on the LCX06C

Note

The LED display management on the LCX06C must be enabled from the "Functionalities" tab of the MCXShape configurator tool. Tick the "Enable LCX support" check box.

2.2.2 LCD display

Note

The LCD display management must be enabled from the "Functionalities" tab of the MCXShape configuration tool. Tick the "Enable LCD support" check box.

The first screen displays:

- the measurement detected by two analog inputs and/or the setpoint value, (see "*display A*" and "*display B*" parameters);
- the symbols of the main active functions, (see figure).

With "*Lbr*" and "*Hbr*" parameters you define the brightness low level and high level. For energy saving reasons, the brightness level switches from high to low after "*brt - display sleep delay*" period of inactivity.

Standard display (128x64 pixel)

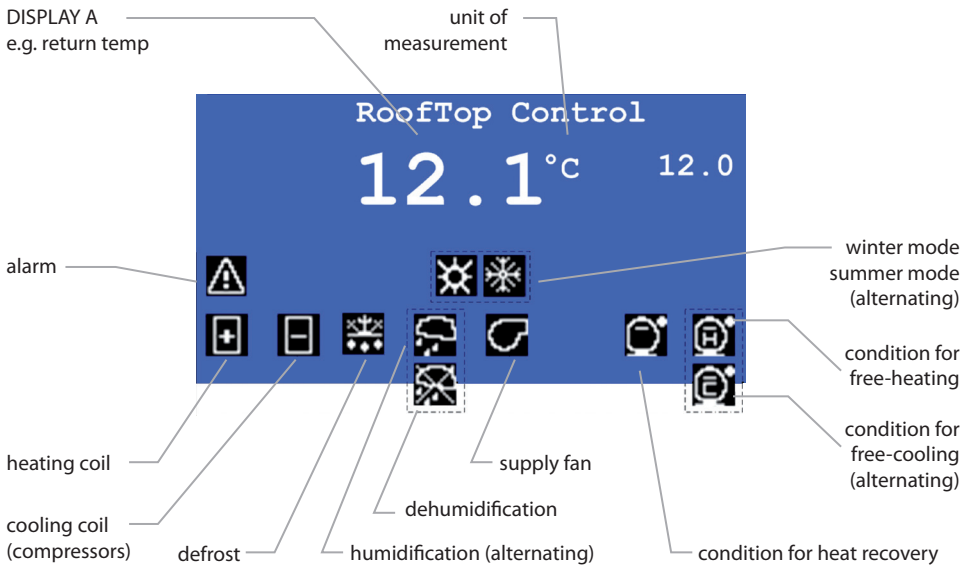


Fig 2 [User interface - LCD display - 128x64 pixel]

MCX06D display (98x64 pixel)

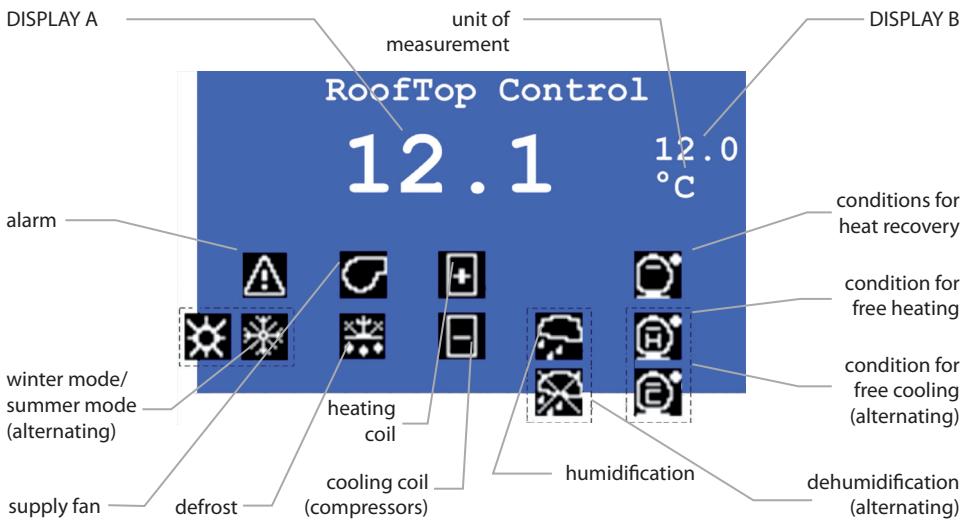


Fig 3 [User interface - LCD display - 98x64 pixel]

2.3 Menu-based navigation

Press the key to access the menu described in the table below.

Menu Level #1	Menu Level #2	Menu Level #3	Function
SeM - Set Mode			
	SON - Unit On		Turn the unit ON
	SOF - Unit Off		Turn the unit OFF
	SSM - Set Summer		Sets the summer operating mode
	SSW - Set Winter		Sets the winter operating mode
	STS - Auto Mode		Sets the automatic operating mode
ALA - Alarms			
	AAL - Active Alarms		Lists all currently active alarms
	ALR - Reset Alarms		Used to manually reset alarms
	AHS - Alarm History		Presents the alarm history
	CLR - Clear AL History		Used to clear alarms history
LOG - Login			Login: specifies the level of access to menus and parameters. The password is defined by parameters "*L01*", "*L02*" and "*L03*"

Menu Level #1	Menu Level #2	Menu Level #3	Function
PAR - Parameters			Accesses the parameters menu. You must login first. For a description of the parameters menu, (see 19.0 "Parameters")
	…		Parameters menu. (See the "*mcxs configuration*" file)
EEV - Config EEV			Used to configure and test the Electronic Expansion Valve
	EV1 - EEV #1		
		CFG - Config EEV1	
		TST - Test EEV1	
		DEF - Load Default	
	EV2 - EEV #2		
		CFG - Config EEV2	
		TST - Test EEV2	
		DEF - Load Default	
IO - Input/Output			Accesses the input/output menu
	IOd - I/O Display		Displays the input/output values
	IOC - I/O Config		Accesses the input/output configuration menu
		DI - Digital Input	Configuration of the digital inputs
		DO - Digital Output	Configuration of the digital outputs
		AI - Analog Input	Configuration of the analog inputs
		AO - Analog Output	Configuration of the analog outputs
	Cal - Probe Calibration		Accesses the probe calibration menu
		CaS - Calibration Set	Set a calibration value for each analog input
		Cre - Reset All	Clear all calibration values
	COM - Commissioning		Accesses the commissioning forms for manual override of output
		OAO - Override AO	Allows override of each analog output
		ODO - Override DO	Allows override of each digital output
		ORT - Reset All	Clear overrides
		OST - Setup override	Configure safety timer to exit from the manual override mode
Utl - Utilities			Accesses utilities functions

Menu Level #1	Menu Level #2	Menu Level #3	Function
	HOU - Hours Counters		Access the hours counters
	HUR - Reset Hour Counters		Clear all the hour counters
	Col - Carter Oil force ON		Force unit ON if it was OFF due to the function for preventing startup with carter oil low temperature
SER - Service			Access service menu
	DFP - Default param		Load default parameter values
	INF - Software info		Info about application software version
	DEV - Device info		Info about MCX Model and firmware
	RTC - RTC Setup		Sets the clock time
	SCH - Scheduler		Sets the weekly programme
	SCC - Clear Scheduler		Clear all the weekly programmes
	SVD - Stepper valves info		Information about the stepper valve status
LNG - Language			User interface languages
	IT - Italian		
	EN - English		
	DE - German		
	FR - French		
	ES - Spanish		
	HE - Hebrew		
	RO - Romanian		
	RU - Russian		
	PL - Polish		
	CS - Czech		
	HU - Hungarian		
	PT - Portuguese		
	CN - Chinese		

Tab 1 [User interface - Menu-based navigation]

Use the ↑ and ↓ keys to navigate through the menu; pressing the ↵ key allows you to descend a level in the menu, if this is possible, and pressing the ✕ key allows you to move up a level.

Use the following keys to modify the selected parameters:

- ↵ to enter the modification mode
- ↑ and ↓ to modify the value
- ↵ to confirm the modification
- ✕ to exit without confirming

2.3.1 Set mode

Menu: SEM – Set Mode

SON – Unit ON
Turn ON the unit.

SOF – Unit OFF
Turn OFF the unit.

SSW – Set Winter
Sets the winter operating mode. Select this function to manage the heating elements only and the "*R03*" working setpoint.

SSM – Set Summer
Sets the summer operating mode. Select this function to manage the cooling elements only and the "*R02*" working setpoint.

STS – Auto Mode
Sets the automatic operating mode. Summer or winter mode is automatically selected according to parameter "*CF2*", (see 4.2 "Choice of control modes").

For a complete description of how to select the active temperature setpoint,
(see 4.3 "Definition of the temperature setpoint").

2.3.2 Alarms display and management

Menu: ALA – Alarms

Sub-menu: AAL – Active Alarms
Displays the active alarms.
Screen with description of the alarm (LCD), and alarm code.

Please note that you can go to the alarm screen by pressing the ✕ key directly from the main screen.

Each screen is dedicated to a specific alarm. Use the ↑ and ↓ keys to move from one screen to the next.

To reset all alarms, press and hold the ↵ key for 3s or use the sub-menu "*RAL – Reset*".

Sub-menu: RAL – Reset Alarms
Resets the alarms.

Press the ↵ key to manually reset all active alarms.

Sub-menu: SAL – Alarm History
Displays the history of the alarms which are no longer active. The screens present the alarm code, description (LCD) and duration in days, hours, minutes and seconds. Each screen is dedicated to a specific alarm. Use the ↑ and ↓ keys to move from one screen to the next.

Sub-menu: CLR – Clear Alarm History
Clear the alarm history.

2.3.3 Login

Menu: LOG – Login
Insert the password that defines the level of access to menus and parameters.

Press the ↑ and ↓ keys to modify the value of the digit selected.

Press the ↵ key to confirm the value and move on to the next digit, if present, or to login.

The ← and → keys, if present, make it possible to move the cursor to the desired digit.

The passwords for access levels 1, 2 and 3 are defined respectively with parameters "*L01*", "*L02*" and "*L03*".
If you have not logged in, your access level is 0.
You are not allowed to access any parameter and menu belonging to a higher access level than yours.
The level for each menu and parameter is defined in the "*mcxs configuration*" file through the MCXShape configuration tool, (see "MCXShape user manual").

2.3.4 Parameters

Menu: PAR - Parameters
Provides access to the parameters.
For a description of the parameters management submenus, (see 19.0 "Parameters").

2.3.5 Input/output display and configuration

Menu: IO – Input/Output

Submenu: IOd – I/O Display

LED Display

The input and output values are displayed in sequence (↑ and ↓ keys), indicating the input and output tags on display A ("*AI*" for analog inputs; "*AO*" for analog outputs; "*dI*" for digital inputs and "*dO*" for digital outputs) while the value is shown on display B (analog inputs which are not present or are in alarm mode are indicated with ----).

LCD Display
It is used to call up the three screens that display all inputs and outputs; each screen can display a group of eight inputs and outputs. Use the ↑ and ↓ keys to move from one screen to the next. The second and third screens are only for the MCX15B and MCX20B.

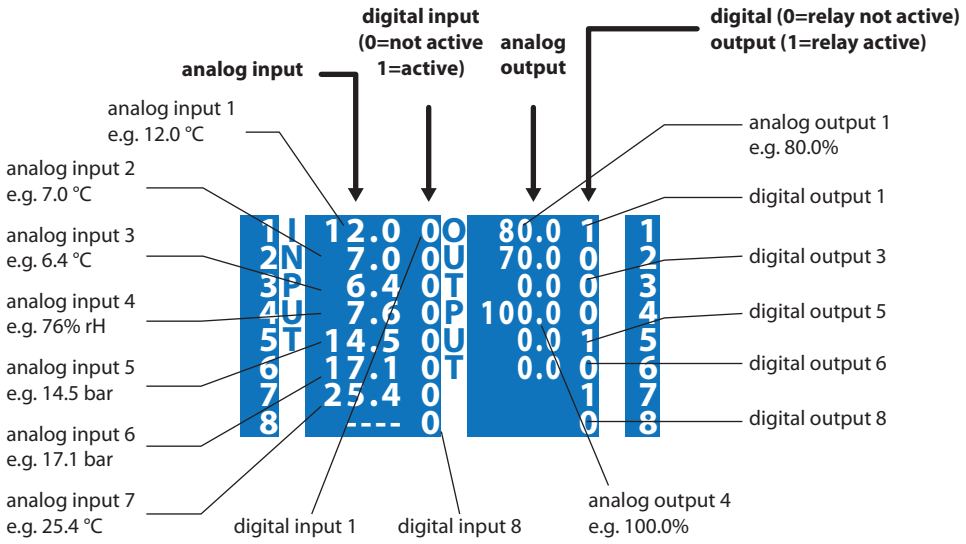


Fig 4 [User interface - Input/output display and configuration]

Submenu: IOC – I/O Config

Note

This function must be enabled from the "Functionalities" tab of MCXShape configuration tool. Tick the "Enable IO dynamic configuration" check box.

Makes it possible to access the input and output configuration screens.
For each input and output of the device, it is possible to set the following properties:

- **FUN**: function performed by the input and output. The function is selected from among those listed in the "*Function*" column of the MCXShape configuration tool, (see 3.1 "Input and output configuration").
- **TYP**: type, from among those available for the used MCX model ("*Type*" column of the MCXShape configuration tool). The type has to be chosen according to the technical characteristics of the device.
- **CAL**: calibration value of the analog input (offset added to the analog input reading value).
- **MIN/MAX**: operating range of the analog inputs. For the temperature probes (NTC and PT1000), it identifies the values beyond which a probe alarm is generated. For the active probes, it indicates the input full scale measurement value.
- **DEL**: Only for active probes. It is the percentage defining the real working range of the probe. For 0/5 V ratiometric probes, set it to 10% to restrict the working range from 0.5 V to 4.5 V.
- **ERR**: analog input over range admission. States if an error is generated when the input signal is outside its effective working range. If "*ERR=YES*" an alarm is generated.

Submenu: Cal – Probe Calibration

Note

This function must be enabled from the "Functionalities" tab of the MCXShape configuration tool. Tick the "Enable AI probe calibration" check box.

Makes it possible to adjust the value read by each analog input.

Calibration set
Makes it possible to define a calibration value (probe delta) to be added to each analog input.

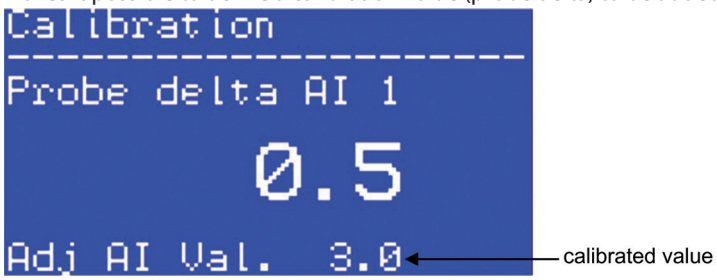


Fig 5 [User interface - Input/output display and configuration - Calibration]

Reset All
Delete all calibration values.

Submenu: COM – Commissioning
Commissioning forms for the override of output from the MCX user interface.
Note that this function must be enabled from the "*Functionalities*" tab of MCXShape configurator tool.
Tick the Enable Override of physical input and output and Enable commissioning forms check boxes.

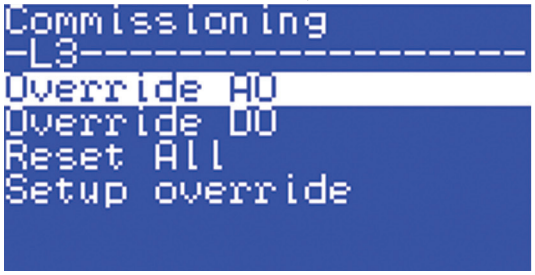


Fig 6 [User interface - Input/output display and configuration - Commissioning]

Override AO – Override DO
Allow manual override of analog and digital output logic functions.
Logic functions are assigned to the MCX physical output through the "*Digital output*" and "*Analog Output*" tabs of MCXShape configurator tool.
Pay attention to the fact that the override will force the output in the desired position and the output will maintain that status until the "*Reset All*" command is executed or a safety timeout expires.
Eventual alarms will not affect the status of the output which has been manually set.
When an output status is manually set, the service icon is displayed.
In the next figure the digital output used to drive the first compressor is forced ON.

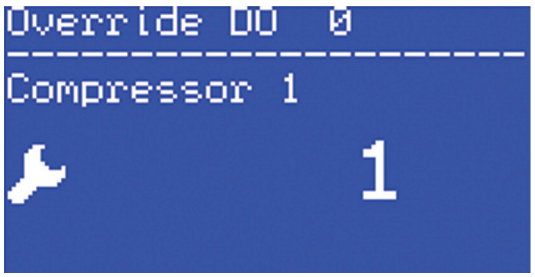


Fig 7 [User interface - Input/output display and configuration - Override]

Reset All
Disable all manual output settings.

Setup Override
The safety timeout timer "*Ovt*" is set through the menu "*Setup override*".
If the timer is 0 it is disabled. When the timer expires, the outputs which have been manually set will go back to the status defined by the application software.

Input/Output Override from Modbus network
(See 20.2 "Input/output override from Mosbus network").

2.3.6 Utilities

Menu: Utl – Utilities

Submenu: HOU – Hours Counters
Accesses the counters that indicate the hours of operation for the unit actuators: compressors, condenser fans (three steps for each condenser) and supply fan.

Submenu: HUR - Reset Hour Counters
Reset all the hour counters.

Submenu: Col - Carter Oil force ON
Force the unit ON even if it is waiting for the oil to warm up.

2.3.7 Service

Menu: SER – Service

Sub-menu: DFP – Default Param
Load default parameters.

Submenu: INF – Software Info
Shows software information.

Submenu: DEV – Device Info
Shows device information.

Submenu: RTC – RTC Setup
Sets the time and date of the internal real time clock.

Use the ↑ and ↓ keys to navigate through the fields.

Use the ↵ key to start changing the value of the selected field.

Sub-menu: SCH – Scheduler
Access the configuration of the scheduler.

Note

The scheduler function must be enabled from the "Functionalities" tab of the MCXShape configurator tool. Tick the "Enable Scheduler" check box.

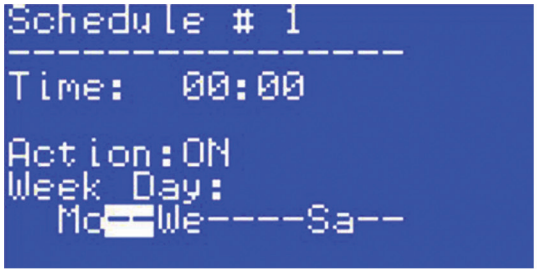


Fig 8 [User interface - Input/output display and configuration - Schedule]

Up to 10 records can be managed.
This is the screen for the first one:

- **Time**: time of the action start
- **Action**: action type. Two types of action are managed:
  - turn ON the unit
  - turn OFF the unit
- **Week day**: day of the week of the action

Use the key to change the field. Use the and keys to modify the value.

When you are not in edit mode (no field in reverse), use the and keys to change the schedule record. The scheduler is activated by the parameter "*y10*".

Sub-menu: SCC – Clear Scheduler
Clear all the schedulers.

Sub-menu: SVD – Stepper valves info
Shows information about the status of the internal driver for stepper valves on MCX061V and MCX152V.

2.3.8 Language

Menu: LNG – Language

Sub-menu: EN – <language>

Load the selected language on the MCX user interface. The language has been previously enabled by MCXShape configurator tool (English and German in the picture below).

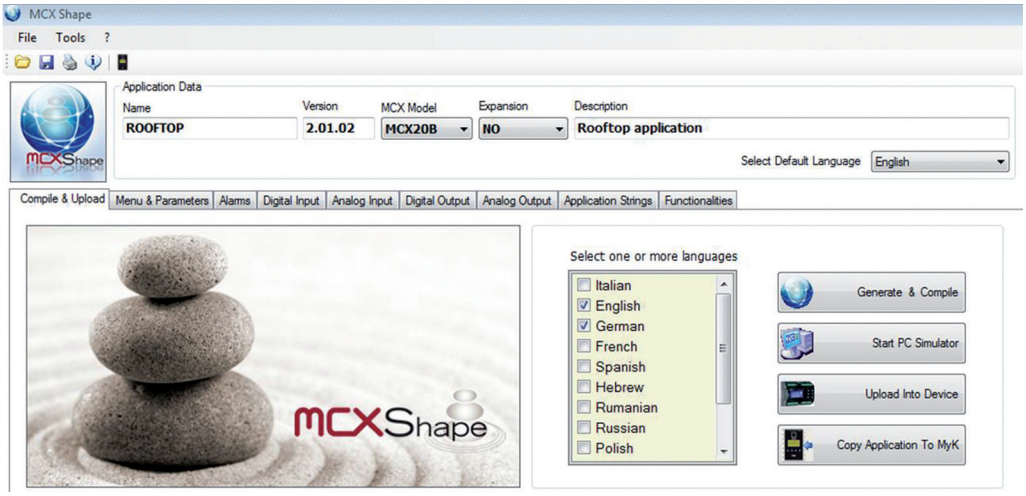


Fig 9 [User interface - Language]

2.4 Unit setup

The following parameters in "GEN-General/StU-Setup" are used for general unit setup:

Code	Description	Values	Function
y01	System ON/OFF	OFF;ON	See 2.1 "Turning the unit ON and OFF"
y02	Restore default parameters	0;1	Load parameters default values as defined in the "Value" column of the MCXShape configurator tool
y04	Date format	YMD;DMY	Year-Month-Day or Day-Month-Year
y06	Set summer time	Auto;Std;DST	Auto=time is automatically changed according to y07 Std=standard time DST=time is fixed according to y07
y07	DST type	US;EU	US=Daylight Saving Time for United States and Canada EU=Daylight Saving Time for Europe
y10	Scheduler Mode	NO;YES	YES=enabled
Ver	Parameter Version		Keeps track of the version of the configuration parameters list

Tab 2 [User interface - Unit setup]

3.0 Choice of rooftop models

The type of rooftop to be controlled is defined by configuring the parameters described below and defining the inputs and outputs to be used to control the various elements that make up the unit. Both the parameters and the inputs and outputs can be configured from the instrument user interface, (see 2.0 "User interface"), or from a PC using the MCXShape configuration tool and the "*mcxs configuration*" file supplied with the algorithm, (see "MCXShape user manual").

3.1 Input and output configuration

Below is a complete list of the functions available.
T hese functions can be assigned independently for each input and output.

Analog inputs

Code (LED and LCD)	Description (LCD)	Function
SUP	Supply Temp	Supply air temperature
REt	Return Temp	Return air temperature
OUt	Outdoor Temp	Outside air temperature
tC1	AntiFrostTempC1	Antifrost temperature circuit 1
tC2	AntiFrostTempC2	Antifrost temperature circuit 2
bAR	Air Pressure	Air pressure
SHU	Sup. Humidity	Supply air humidity
RHU	Ret. Humidity	Return air humidity
CO2	CO2	Air carbon dioxide (CO2) measurement
VOC	VOC	Air volatile organic compounds (VOC) measurement
Cd1	Condenser 1	Condenser 1 control
Cd2	Condenser 2	Condenser 2 control
TREM	Remote Set	Remote Setpoint
OHu	Outdoor Humidity	Out door humidity
SP1	Suction Pressure C1	Suction pressure circuit 1 (used for superheat control and pumpdown)
SP2	Suction Pressure C2	Suction pressure circuit 2 (used for superheat control and pumpdown)
ST1	Suction Temperature C1	Suction temperature circuit 1 (used for superheat control)
ST2	Suction Temperature C2	Suction temperature circuit 2 (used for superheat control)
DT1	Discharge Temperature C1	Discharge temperature circuit 1
DT2	Discharge Temperature C2	Discharge temperature circuit 2

Code (LED and LCD)	Description (LCD)	Function
Amb	Ambient temperature	Ambient temperature used for temperature control if selected with parameter "*CF1-Regulation Type*", (see 4.1 "Selecting the probes")
AP1	Alarm Probe 1	Auxiliary alarm probe 1, (see 18.6 "Auxiliary alarms")
AP2	Alarm Probe 2	Auxiliary alarm probe 2, (see 18.6 "Auxiliary alarms")
AP3	Alarm Probe 3	Auxiliary alarm probe 3, (see 18.6 "Auxiliary alarms")
AP4	Alarm Probe 4	Auxiliary alarm probe 4, (see 18.6 "Auxiliary alarms")

Tab 3 [Choice of rooftop models - Analog inputs]

Digital inputs

Code (LED and LCD)	Description (LCD)	Function
ASF	SupFan Alarm	Supply Fan alarm
CSS	SupDamp Closed	Supply Damper closed
SSS	SupFan SafeSW	Supply Fan safety switch (port open)
CSE	ExtDamp Closed	External Damper closed
ONF	ON/OFF	Remote ON/OFF
AFI	Fire Alarm	Fire alarm
AAI	Freeze Alarm C1	Freeze alarm circuit 1
AA2	Freeze Alarm C2	Freeze alarm circuit 2
CH	Summer/Winter	Summer/Winter selection
SFW	Supply Flow	Supply flow alarm
SFI	Supply Filter	Supply air filter plugged
HPU	Heating Pump	Heating pump alarm
HUM	HumidityAlarm	Humidifier alarm
REC	RecoveryAlarm	Energy recovery alarm
GEN	General Alarm	General alarm
C10	Cond1GenAlarm	General alarm of condenser 1
C11	Cond1 Stage1	Step 1 alarm of condenser 1
C12	Cond1 Stage2	Step 2 alarm of condenser 1
C13	Cond1 Stage3	Step 3 alarm of condenser 1
C20	Cond2GenAlarm	General alarm of condenser 2
C21	Cond2 Stage1	Step 1 alarm of condenser 2

Code (LED and LCD)	Description (LCD)	Function
C22	Cond2 Stage2	Step 2 alarm of condenser 2
C23	Cond2 Stage3	Step 2 alarm of condenser 3
CPG	CompGenAlarm	General alarm of compressors
CP1	Comp1 Alarm	Compressor 1 alarm
CP2	Comp2 Alarm	Compressor 2 alarm
CP3	Comp3 Alarm	Compressor 3 alarm
CP4	Comp4 Alarm	Compressor 4 alarm
HEG	HeaterGenAlarm	General alarm of heaters
HE1	Heater1 Alarm	Heater 1 alarm
HE2	Heater2 Alarm	Heater 2 alarm
HE3	Heater3 Alarm	Heater 3 alarm
HE4	Heater4 Alarm	Heater 4 alarm
DEF	Defrost	Start/stop defrost
LP1	LowPressure1	Low pressure circuit 1
HP1	HighPressure1	High pressure circuit 1
LP2	LowPressure2	Low pressure circuit 2
HP2	HighPressure2	High pressure circuit 2
OSP	Offset setpoint	Offset setpoint
GD1	Aux alarm 1	Auxiliary alarm 1
GD2	Aux alarm 2	Auxiliary alarm 2
GD3	Aux alarm 3	Auxiliary alarm 3
GD4	Aux alarm 4	Auxiliary alarm 4

Tab 4 [Choice of rooftop models - Digital inputs]

Digital outputs

Code (LED and LCD)	Description (LCD)	Function
ALA	Alarm	Alarm
WAR	Warning	Warning
SUF	Supply Fan	Supply Fan control
SSH	Supply Damper	Supply Damper control
ESH	External Damper	External Damper ON/OFF control
ESO	External Damper Open	3-point External Damper open command
ESC	External Damper Close	3-point External Damper close command
SFL	SupplyFanLowq	Low Supply Fan speed

Code (LED and LCD)	Description (LCD)	Function
SFH	SupplyFanHigh	High Supply Fan speed
dEU	Dehumidifier	External dehumidifier control
HUM	Humidifier	External humidifier control
HEP	Heating Pump	Heating pump control
ARE	Recovery	Energy recovery control
PRE	Recovery Pump	Controls the dual coil pump for energy recovery
b1	Valve1ONOFF	Controls the ON/OFF valve of heating coil
b1O	Valve1Open	Controls opening of 3-point valve of heating coil
b1C	Valve1Close	Controls closing of 3-point valve of heating coil
b11	Heater1	Controls step 1 of heating coil
b12	Heater2	Controls step 2 of heating coil
b13	Heater3	Controls step 3 of heating coil
b14	Heater4	Controls step 4 of heating coil
C1	Compressor 1	Controls compressor 1
P11	Comp1 Step1	Controls unloader 1 of compressor 1
P12	Comp1 Step2	Controls unloader 2 of compressor 1
P13	Comp1 Step3	Controls unloader 3 of compressor 1
C2	Compressor 2	Controls compressor 2
P21	Comp2 Step1	Controls unloader 1 of compressor 2
P22	Comp2 Step2	Controls unloader 2 of compressor 2
P23	Comp2 Step3	Controls unloader 3 of compressor 2
C3	Compressor 3	Controls compressor 3
P31	Comp3 Step1	Controls unloader 1 of compressor 3
P32	Comp3 Step2	Controls unloader 2 of compressor 3
P33	Comp3 Step3	Controls unloader 3 of compressor 3
C4	Compressor 4	Controls compressor 4
P41	Comp 4 Step1	Controls unloader 1 of compressor 4
P42	Comp 4 Step2	Controls unloader 2 of compressor 4
P43	Comp 4 Step3	Controls unloader 3 of compressor 4
C10	Cond1Inverter	Controls inverter of condenser 1
C11	Cond1 Stage1	Controls step 1 of condenser 1
C12	Cond1 Stage2	Controls step 2 of condenser 1
C13	Cond1 Stage3	Controls step 3 of condenser 1

Code (LED and LCD)	Description (LCD)	Function
C20	Cond2Inverter	Controls inverter of condenser 2
C21	Cond2 Stage1	Controls step 1 of condenser 2
C22	Cond2 Stage2	Controls step 2 of condenser 2
C23	Cond2 Stage3	Controls step 3 of condenser 2
ICO	Inverter Comp	Controls inverter of compressor
VHP	ReverseValveC1	Controls reversing valve circuit 1
VH2	ReverseValveC2	Controls reversing valve circuit 2
LV1	Liquid Valve Circ1	Liquid valve circuit 1
LV2	Liquid Valve Circ2	Liquid valve circuit 2
G01	Aux alarm 1 on	Auxiliary alarm 1
G02	Aux alarm 2 on	Auxiliary alarm 2
G03	Aux alarm 3 on	Auxiliary alarm 3
G04	Aux alarm 4 on	Auxiliary alarm 4

Tab 5 [Choice of rooftop models - Digital outputs]

Analog outputs

Code (LED and LCD)	Description (LCD)	Function
SUF	Supply Fan	Supply Fan control
ESR	External Damper	External damper control
HUM	Humidifier	Humidifier control
ARE	Recovery	Energy recovery control
bA1	Valve1	Heating coil control
Cv1	Condenser 1	Controls inverter of condenser 1
Cv2	Condenser 2	Controls inverter of condenser 2
TRI	Inverter Comp	Controls inverter of compressor
SH1	Super Heat Valve 1	Controls super heat valve 1
SH2	Super Heat Valve 2	Controls super heat valve 2

Tab 6 [Choice of rooftop models - Analog outputs]

3.2 Parameters configuration

The parameters that define the configuration of the rooftop are described below.
Cooling is always performed using compressors. Heating can be done in several ways.

3.2.1 Cooling circuit configuration

Parameters defining the type of refrigerant circuit are as follows:

H01 – Number of circuits
Defines the number of refrigerant circuits, between 1 and 2.

H02 - Total number of compressors
Defines the total number of compressors that are managed (max 4).
Compressors are assigned to circuits in a sequential and balanced way, assuming that all circuits have the same number of compressors;

In a system made of two circuits and four compressors, "C1 - Compressor 1" and "C2 - Compressor 2" output are assigned to control compressors belonging to the first circuit; "C3 - Compressor 3" and "C4 - Compressor 4" to the second circuit.

H03 - Number of unloaders per compressors
Defines the number of unloaders (max 3) per compressor.
One digital output "*P11 - Comp1 Unloader1*", ..., "*P43 - Comp4 Unloader3*" to drive the unloading valve corresponds to each unloader per compressor.

H04 – Number of condensers
Defines whether the unit is made of one or two separate condensers.

H05 – Number of fans on condenser 1
Defines the number of fans of the first condenser.

H06 - Number of fans on condenser 2
Defines the number of fans of the second condenser.

H11 – Fans in common to all condensers
If "*H11=YES*" and there are two condensers "*H04=2*", fans are considered in common to the two condensers.

3.2.2 Heating configuration

H07 – Heating type
Defines the method used to heat the air. With hot water through a 3-ways valve, with electrical heaters or reversing the refrigerant flow:

- if "*H07=VALV*" heating is controlled through a water valve. Depending on the type of valve to be operated, the following outputs are used:

Type of valve	Output used
ON/OFF	digital output "*b1 - Valve1ON/OFF*"
0/10 V	analog output 0/10 V "*bA1 - Heating*"
3-points	digital output "*b1O - Valve1Open*" to open digital output "*b1C - Valve1Close*" to close

- If "*H07=RES*" heating is obtained through electrical heaters.
  To activate heaters, the following outputs are used:
  - "*b11 - Heater1*"
  - "*b12 - Heater 2*"
  - "*b13 - Heater 3*"
  - "*b14 - Heater 4*"

- If "*H07=HP*" heating obtained by reverting the gas flow through the output "*VHP - ReverseValve*". Heaters and water valve can also support compressors

H08 – Number of heaters
Defines the number of electrical heaters used for heating (max=4).

H09 – Valve run time
Indicates the time the 3-point valve takes to go from fully closed to fully open.
The valve control algorithm uses this time to calculate the activation time for the outputs "*b1O - Valve1Open*" and "*b1C - Valve1Close*" according to what is required by regulation.

H10 – Enable support to HP
If "*H7=HP*" defines if heaters (and the hot water valve) are used to support compressors when the controlled temperature goes below a certain limit.

3.2.3 Fans configuration

Parameters defining the type of fans are described at, (see 15.0 "Supply fan and damper").

3.2.4 Dampers configuration

The external air damper can be:

- **ON/OFF** controlled by the digital output "*ESH - External Damper*". Opening occurs when the demand is above 50%
- **3-points** controlled by:
  - the digital output "*ESO - External Damper Open*" for opening
  - the digital output "*ESC - External Damper Close*" for closing
- **Modulating** controlled by the analog output "*ESR - External Damper*"

dE1 – Minimum external opening
This defines the minimum opening setting for the external damper.

dE2 – Damper run time
The damper full excursion time indicates the time the "*3P*" damper takes to go from fully closed to fully open. Depending on the time the contact is activated, the extent to which the damper is opened varies from 0% to 100% of the excursion time. The relays are never activated simultaneously, thus the dampers either open, or close, or remain still.
To obviate the lack of feedback about the damper opening degree, the following rules apply:

- when the instrument is turned ON, the damper is closed or open all the way for an amount of time equal to the excursion time + 25%, and the position of the damper is realigned before regulation is started
- whenever the temperature regulation requires opening or closing a damper all the way, the programme increases the opening or closing relay activation time by 25% to ensure that the damper opens or closes all the way

dE3 - Period of forcing damper at max
If the damper is fully open or fully closed, the opening or closing command is periodically set for a time equal to 25% of the full excursion time.
The frequency of this command is defined in this parameter.

dE4 – Damper minimum variation
This is the minimum shift performed by the damper, and is useful for avoiding moving the damper when the change on demand is small.

dE5 – Damper range
If the damper is set to a position lower than this parameter (as a percentage of the fully open or fully closed position), the damper will open or close all the way. E.g. "*dE5=5%*" means that a request for a 4% position will cause the damper to fully close and a request for 96% will cause it to open all the way. The supply damper is the ON/OFF type only and is controlled by the digital output "*SSH - Supply Damper*".

4.0 Temperature control

4.1 Selecting the probes

Parameter "*CF1 - Regulation type*" is used to define the temperature control probe that will be used. Possible values are:

- "*CF1=SUP*": supply probe, "*SUP - Supply Temp*"
- "*CF1=REt*": return probe, "*REt - Return Temp*"
- "*CF1=Amb*": ambient probe, "*Amb - Ambient Temperature*"

4.1.1 Probe average

Note

This function must be enabled from the "Functionalities" tab of the MCXShape configuration tool. Tick the "Enable average of multiple analog input" check box.

If more than one analog input with the same function has been defined (e.g. "*AI1=AI2=Return Temp*") then the value of that function (Return Temperature in this case) is calculated as the average of all the values read by the associated analog inputs.

4.2 Choice of control modes

There are two possible control modes; summer and winter:

- **summer mode** is characterised by the management of the cooling elements only and by the "*R02*" working setpoint
- **winter mode** is characterised by the management of the heating elements only and by the "*R03*" working setpoint

The choice of summer or winter control mode is made with the parameter "*CF2 - Winter/Summer auto changeover*":

- "*CF2=MAN*" the choice is made by a supervisor or user interface "Set Mode" menu. The default mode is set by "*CF5*"
- "*CF2=SUP, RET, OUT*" the choice is made by comparing a probe and a setpoint; in this case the probe is defined with "*CF2*" among the following:
  - supply probe, "*SUP - Supply Temp - CF2=SUP*"
  - return probe, "*REt - Return Temp - CF2=REt*"
  - outdoor probe, "*OUt - Outdoor Temp - CF2=OUt*"

  Setpoint is defined in "*CF3*" and differential in "*CF4*", (see figure).
  When this mode is enabled it has priority over all the others.

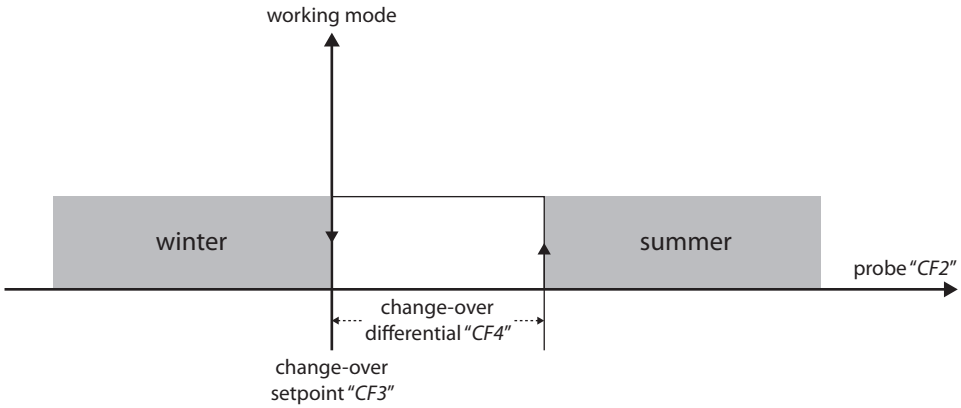


Fig 10 [Temperature control - Choice of control mode 01]

- "*CF2=SET*" the choice is automatically made according to the position of the controlled temperature in respect of the winter and summer setpoint:
  - if Tcontrol probe "*CF1*" > summer setpoint "*R02*", then the mode is summer
  - if Tcontrol probe "*CF1*" < winter setpoint "*R03*", then the mode is winter. When this mode is enabled it has priority over all the others

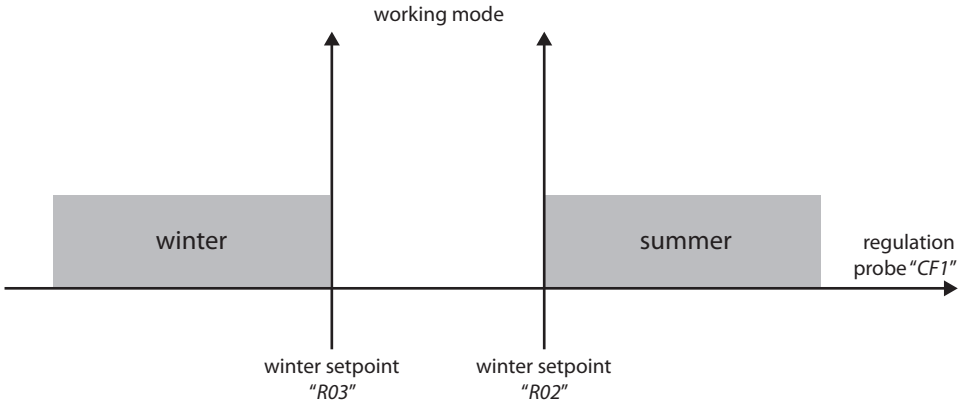


Fig 11 [Temperature control - Choice of control mode 02]

- "*CF2=DIG*" the choice is made with digital input "*CH - Summer/Winter*"

Note

Digital input is sensitive only to the change of state. With input polarity="N.C." (normally closed), when the input is closed the summer mode is selected.

4.3 Definition of the temperature setpoint

The active temperature setpoint is different if in summer or winter working mode, (see 4.2 "Choice of control modes"). In summer it is "*R02*" and in winter it is "*R03*".

The setpoint can be modified through the keyboard, changing the according parameter, or in the ways described below.

4.3.1 Second setpoint

By activating the digital input "*OSP - OffsetSetPoint*", the offset "*R05*" and "*R04*" are respectively added to the setpoint "*R02*" and "*R03*".

4.3.2 Setpoint compensation

Setpoint compensation acts on the active temperature setpoint.

Use "*R20*" to select the probe to be used as reference for compensation.

- "*R20=SUP*" supply probe, "*SUP - Supply Temp*"
- "*R20=REt*" return probe, "*RET - Return Temp*"
- "*R20=OUt*" outside probe, "*OUt - Outdoor Temp*"
- "*R20=tC2*" antifreeze probe, "*tC2 - AntiFreeze*"

The other parameters that control compensation are described in the figure below.

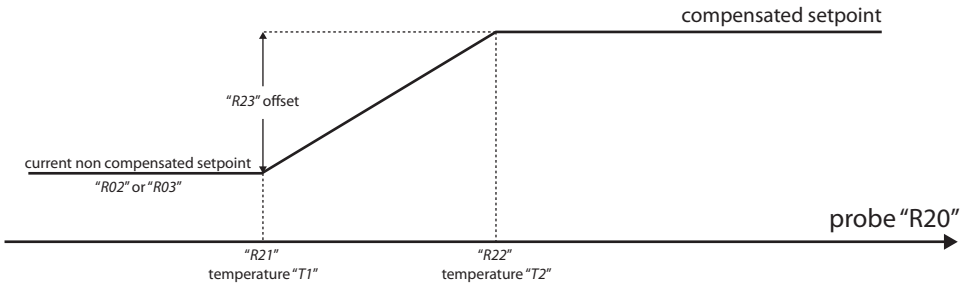


Fig 12 [Temperature control - Setpoint compensation]

4.3.3 Remote setpoint

If "*SRE - Remote Set Enable*" is different from NO, the setpoint is calculated in the following way:

- if "*SRE=rEL*" new set= active set + VAL (relative remote setpoint)
- if "*SRE=Abs*" new set = VAL (absolute remote setpoint)

"*VAL*" is calculated according to the value read by the "*Remote Set*" analog input as described in the figure below.

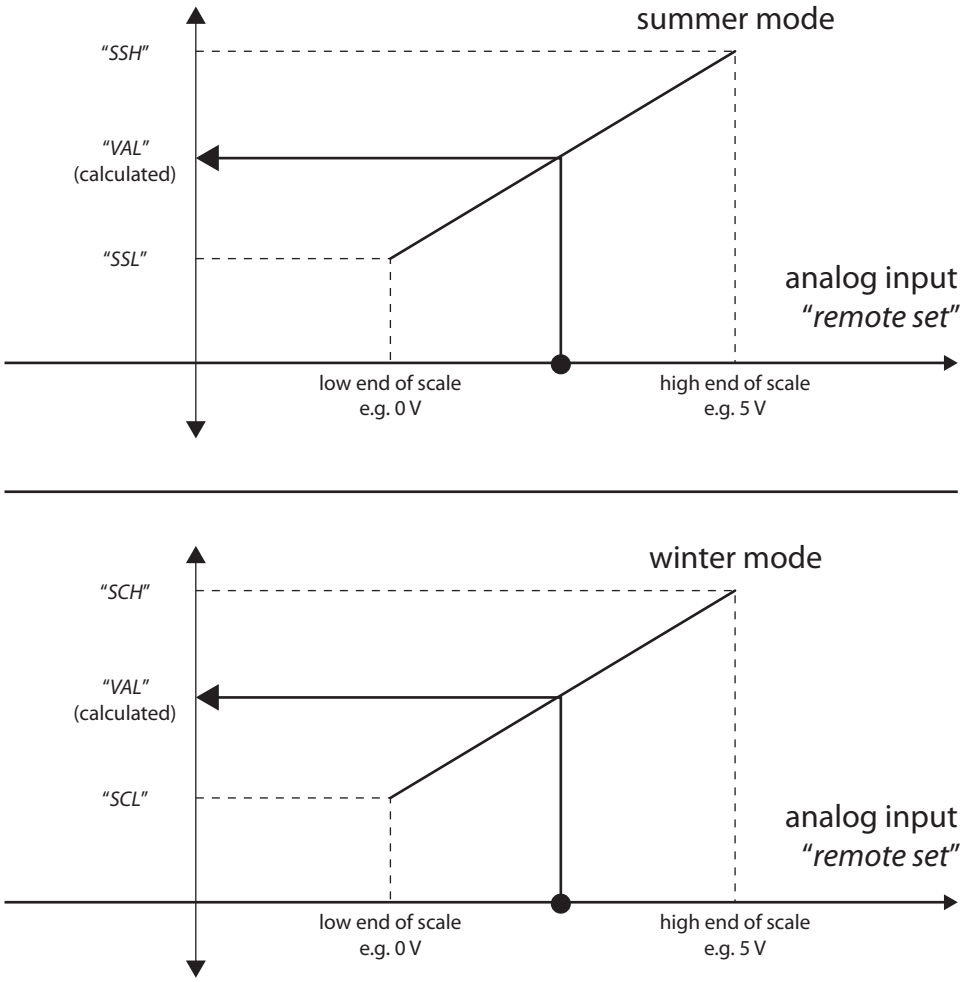


Fig 13 [Temperature control - Remote setpoint]

4.4 Proportional+Integral +Derivative (PID) control

The return or supply temperature, both in heating and in cooling, is regulated with "*PID*" logic. (See 5.0 "Cooling control") and (see 6.0 "Heating control").

5.0 Cooling control

The cooling module is used both for cooling and for dehumidification, and it uses compressors.

To define the outputs used for controlling it, (see 3.0 "Choice of rooftop models").
To enable cooling you must be in summer mode, (see 4.2 "Choice of control modes").

The temperature control probe is defined through the "*CF1*", between return and supply probe (see 4.1 "Selecting the probes").

The reference setpoint for temperature control is the summer setpoint "*R02*".
Through the "*R12*" parameter it is possible to define a dead zone lateral to the setpoint.
The control is performed with "*PID*" logic, controlled by parameters "*R13*" to "*R16*".

R13 – Differential
Defines the regulation band lateral to the setpoint within which the control determines the entity of its action proportional to the position of the return temperature within the band itself.

R14 – Integral time
Coefficient that determines the response rate for integral regulation (short times correspond to a high response rate).

R15 – Derivative time
Coefficient that determines the entity of the derivative action.

R16 – Overshoot limit
0=no limit;
typical limit: 100-500.

5.1 Compressors control

5.1.1 Step compressors control

Compressors must be of equal power.

The number of regulation steps is calculated according to the number of compressors "*H02*" and any unloaders "*H03*" configured.

To drive the four compressors and eventually the three unloaders per each compressor the following digital output are used:

- Compressor 1: "*C1 - Compressor 1*", "*P11 - Comp1 Step1*", "*P12 - Comp1 Step2*", "*P13 - Comp1 Step3*".
- Compressor 2: "*C2 - Compressor 2*", "*P21 - Comp2 Step1*", "*P22 - Comp2 Step2*", "*P23 - Comp2 Step3*".
- Compressor 3: "*C3 - Compressor 3*", "*P31 - Comp3 Step1*", "*P32 - Comp3 Step2*", "*P33 - Comp3 Step3*".
- Compressor 4: "*C4 - Compressor 4*", "*P41 - Comp4 Step1*", "*P42 - Comp3 Step2*", "*P43 - Comp4 Step3*".

The diagram below shows regulation in the case of four steps.

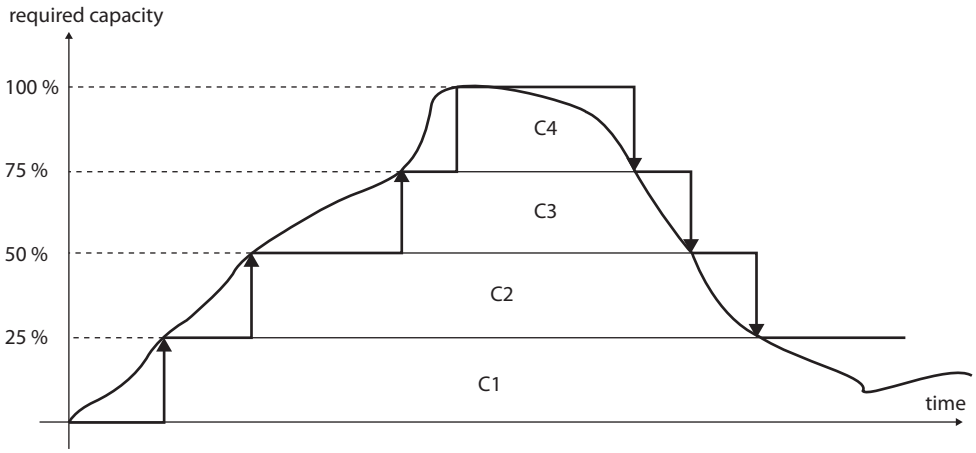


Fig 14 [Cooling control - Step compressors control 01]

When regulation is only proportional, this translates into dividing the band "*R13*" equally among the compressors/steps present.

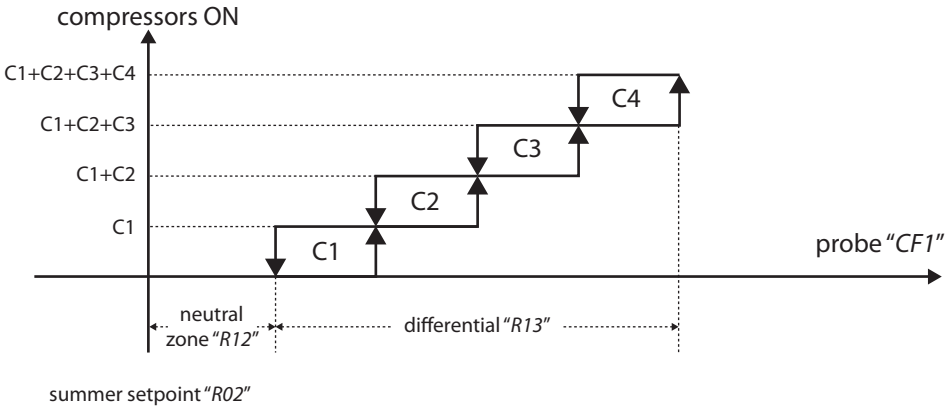
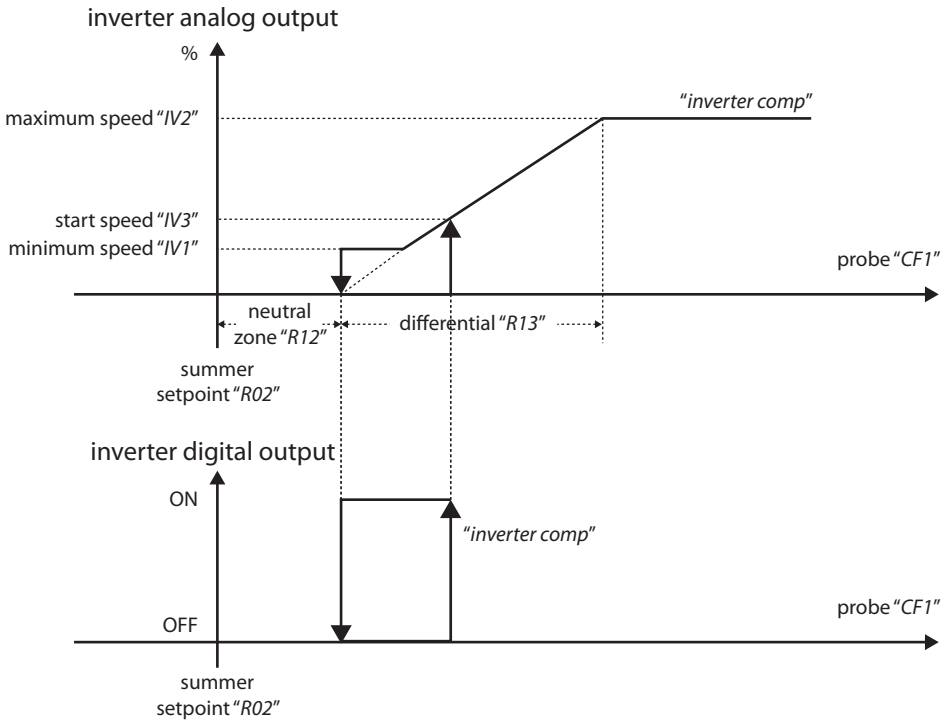


Fig 15 [Cooling control - Step compressors control 02]

5.1.2 Compressors with inverter

When inverter management is enabled with *"IV0=YES"*, the analog "*Inverter Comp*" and the digital "*Inverter Comp*" outputs are used to control the inverter.

"*IV1*", "*IV2*" and "*IV3*" define the percentage values for the inverter minimum and maximum speeds and the inverter starting speed; within these values, the proportional modulating output action is calculated as described in the figure in the case of one compressor.



Regulation diagram for machines with compressor inverter in cooling mode

Fig 16 [Cooling control - Compressors with inverter 01]

The inverter output is activated at the starting rate "*IV3*" (or "*IV2*" for the time "*IV6*" if "*IV6*" is different from 0) when the capacity requested is equal to or greater than that obtained with the inverter at this speed.

Parameter "*IV4*" defines a minimum inverter ON time. Until this time has run out, the inverter continues to run at minimum speed, even if a request to turn it OFF is received. Moreover, IV5 defines a minimum inverter OFF time. Until this time has run out, the inverter remains OFF, even if a request to turn it ON is received.

When additional compressors are present besides the compressor controlled by the inverter, additional compressors are also present, the inverter is used to provide the capacity that the other compressors cannot supply as long as the capacity supplied remains below that requested capacity.

The compressors are assumed to have equal capacity.

The figure below describes the case of four compressors, the first of which is driven by an inverter.

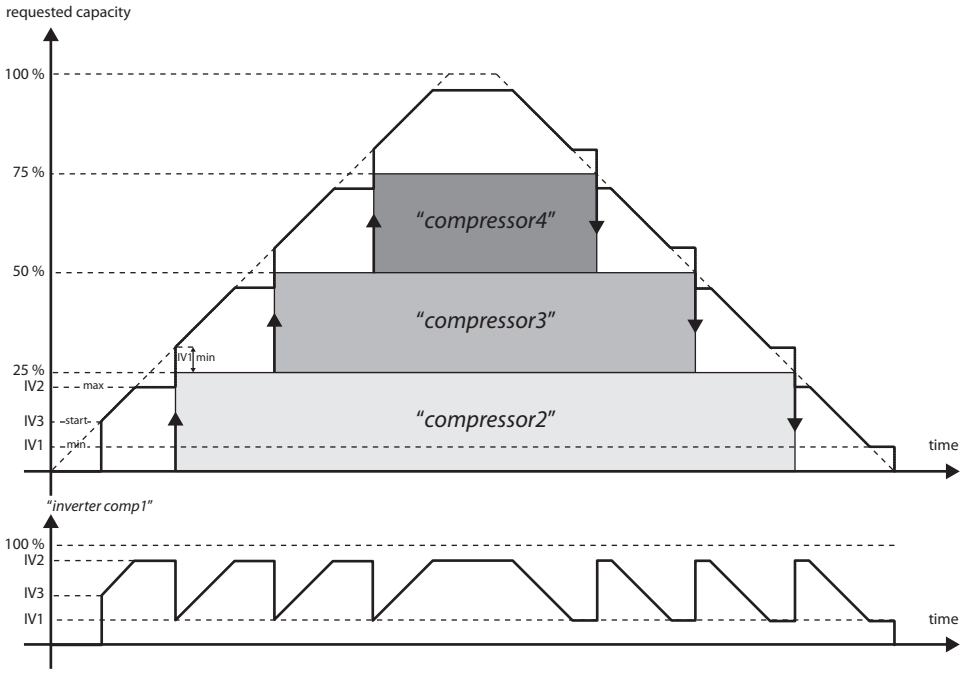


Fig 17 [Cooling control - Compressors with inverter 02]

6.0 Heating control

Heating the air is obtained through the control of some heaters, is performed through the control of some heaters, a hot water valve or compressors in heat pump mode with the support of heaters or a valve. To define the outputs used for controlling it, (see 3.0 "Choice of rooftop models").

To enable heating you must be in cooling mode, (see 4.2 "Choice of control modes").
The temperature control probe is defined through "*CF1*", between return and supply probe, (see 4.1 "Selecting the probe").

The reference setpoint for temperature control is the winter setpoint "*R03*".
Through the "*R06*" parameter it is possible to define a dead zone lateral to the setpoint.

The control is performed with "*PID*" logic, controlled by parameters "*R07*" to "*R10*".

R07 – Differential
Defines the regulation band lateral to the setpoint within which the control determines the entity of its action proportional to the position of the return temperature within the band itself.

R08 – Integral time
Coefficient that determines the response rate for integral regulation (short times correspond to a high response rate). This corresponds to the time that, with constant proportional error, must elapse before the integral error is increased by a value equal to the proportional error.
The integrative action thus also takes into account the time during which the regulated amplitude shifts from the setpoint. This prevents reaching full operation with a constant error, a situation that typically occurs when control is only proportional.

R09 – Derivative time
Coefficient that determines the entity of the derived action.

R10 – Overshoot limit
0=no limit;
typical limit: 100-500.

The following figures describe the status of the heating output in the case of proportional control.

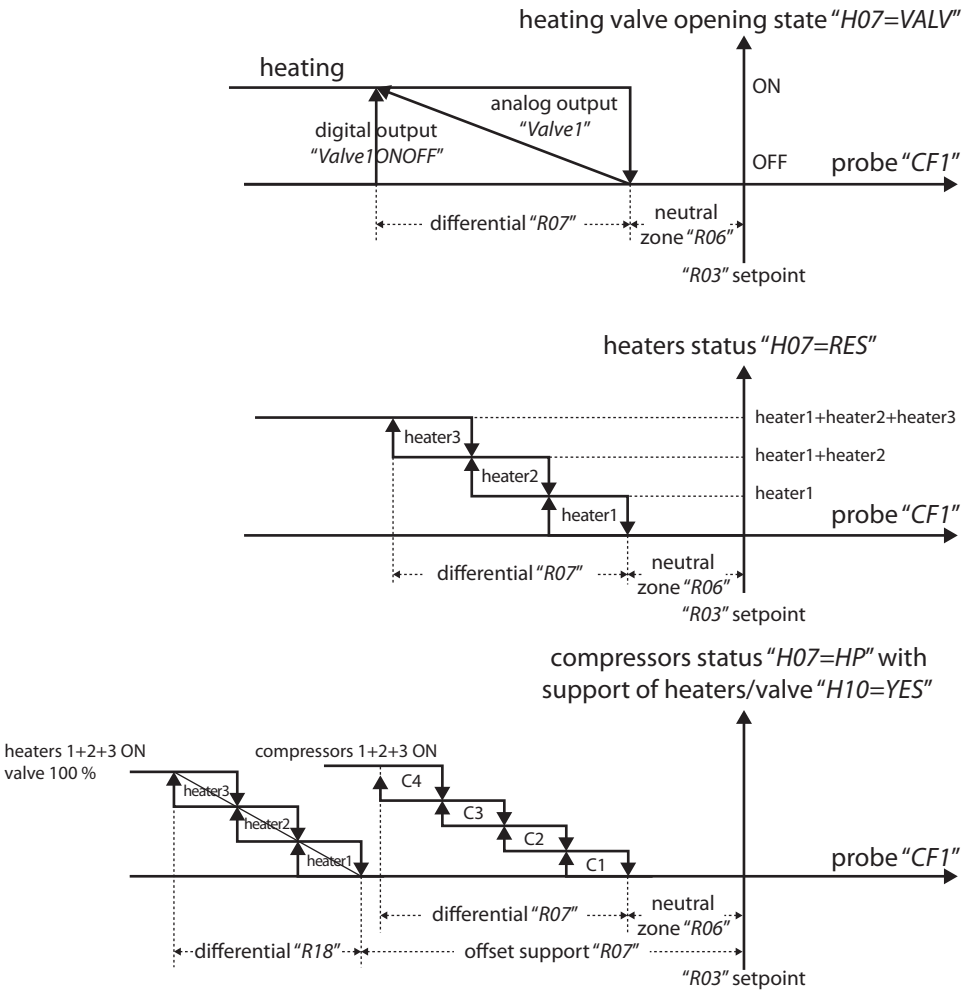


Fig 18 [Heating control - Proportional control]

Reheating during dehumidification

During the action of dehumidification, the heating coil is regulated as defined in the previous section but using the summer setpoint, provided the parameter "*U02*", Temp/Hum priority, is set to NO, (see 14.2 "Dehumidification control").

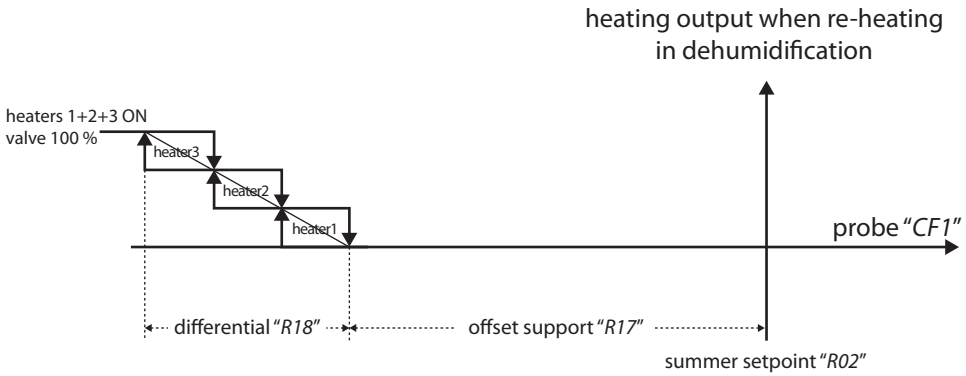


Fig 19 [Heating control - Reheating during dehumidification]

6.1 Compressors control

Compressors are used to heat when the unit is a heat pump, "*H07=HP*", (see 3.2.2 "Heating configuration").

Compressors control is a mirror image of the one in cooling, (see 5.1 "Compressors control").

For the control procedures typical of a heat pump, (see 11.0 "Heat pump").

6.2 Heaters control

Heaters are used to heat when "*H07=RES*", (see 3.2.2 "Heating configuration"), or when the unit is a heat pump and the support of heaters is enabled "*H10=YES*".

In this case, control is performed using a setpoint, calculated by subtracting the offset "*R17*" from the main setpoint "*R03*", and a differential "*R18*", as described in the previous figure.
The number of used heaters is set in "*H08*".

6.3 Control of the heating valve

The valve full excursion time indicates the time the valve takes to go from fully closed to fully open.

Depending on the length of time the contact is activated for the extent to which the valve is opened varies from 0% to 100% of the excursion time. The relays are never activated simultaneously, thus the valves either open, close, or remain still.

To obviate the lack of feedback that provides exact information on the valve opening step, the following rules apply:

- when the instrument is turned ON, the valve is closed or open all the way for an amount of time equal to the excursion time + 25%, and the position of the valve is realigned before regulation is started
- whenever the temperature regulation requires opening or closing a valve all the way, the programme increases the opening or closing relay activation time by 25% to ensure that the valve opens or closes all the way

v01 – Valve minimum variation
This is the minimum shift performed with the valve.

v02 - Valve forcing period
If the valve is fully open or fully closed, the opening or closing command is periodically set for a time equal to 25% of the full excursion time. The frequency of this command is defined in this parameter.

v03 – Valve range
If the valve is set to a position lower than this parameter (as a percentage of the fully open or fully closed position), the valve will open or close all the way.

Example

"b15=5%" means that a request for a 4% position will cause the valve to fully close and a request for 96% will cause it to open all the way.

6.4 Pump control

If present, the heating module pump is activated when there is a request for heating. It is controlled by the digital output "*HEP - Heating Pump*".

6.5 Winter start-up

If the function is enabled ("*R24*" other than 0) and if the outside temperature is below setpoint "*R25*", winter start-up involves:

- closing the external damper
- maximum heat production

all for the time set in "*R24*".

7.0 Compressors

7.1 Compressors configuration

To define the number of compressors and unloaders and the output used to drive them, (see 3.2.1 "Cooling circuit configuration").

7.2 Unloaders control

Unloading a compressor means sharing the power load in several stages.
A digital output "*Comp1 - Step1*", ..., "*Comp4 - Step3*" to drive the unloading valve corresponds to each stage.

Note

Hereinafter, when we talk about switching ON or OFF an unloading valve, it will mean to increase or decrease the number of load steps, independently from the unloading valve working logic.

To manage the load steps, you have to set the number of load steps per compressor "*H03*" and the following parameters:

- start delay "*CT7*" among unloaders or between the compressor's activation and its load step. It avoids the compressor's activation at full load
- the method of switching ON compressors with load steps "*CC3*". If it is set to "*Cp*", the software gives priority to the complete start of each single compressor; otherwise if it is set to "*CCp*" or "*CCp1*", the software first switches ON all compressors and then all the load steps of one compressor "*CCp*" or alternated "*CCp1*"

Example

In a system made of two compressors and two load steps, "p11" and "p12" are the load steps 1 and 2 of compressor 1 and "p21" and "p22" are the load steps 1 and 2 of compressor 2.

  - if "*CC3=CCp*" the activation sequence is "*C1 - C2 - p11 - p12 - p21 - p22*";
  - if "*CC3=CCp1*" the activation sequence is "*C1 - C2 - p11 - p21 - p12 - p22*";

- the method of switching OFF compressors with load steps "*CC4*". If it is set to "*ppCC*", during the compressor switching OFF phase, all the load steps are switched OFF first all the load steps and then the corresponding compressors. This is useful when you need to limit the OFF numbers (and thus the ON numbers) of compressors, in order to save their life. If it is set to "*pCpC*", during the compressor switching OFF phase, the complete OFF of the single compressor given priority, in order to alternate the switched ON compressors more frequently alternate the switched ON compressors

Note

The unloading valve working logic between Normally Closed (N.C.) and Normally Open (N.O.), e.g. whether valves are energised or not when the compressor is at full load, is defined at the physical output configuration phase. If polarity is set to "Open" (as by default) it means that unloaders are energised at full load.

7.3 Rotation

The compressor calls are rotated "*CC1*" in order to balance the number of compressor run hours and start-stops among the units.

Rotation is performed among compressors only, and not among load steps. If the compressor elected by the rotation algorithm to be the next to start or stop cannot do it because of its protection times, it is substituted by the next one (if "*CC2-Smart Rotation=YES*").

The available rotation types are:

- "*CC1=LIFO*"(LastInFirstOut) or not enabled rotation;
  this means that the first compressor to start will be the last to stop. Start: "*C1*, *C2*". Stop: "*C2*, *C1*"
- "*CC1=FIFO*" (FirstInFirstOut);
  this means that the first compressor to start will be the first to stop. Start: "*C1*, *C2*". Stop: "*C1*, *C2*"
- "*CC1=HOUR*" running hours control;
  this means that the compressor to start is the one with the lowest number of run hours;
  the compressor to stop is the one with the highest number of run hours

Note

The resolution of one second is used for the measurement of the running time. The storage of this time in non-volatile memory takes place every five minutes. To reset the hour counter parameter, (see 7.5 "Hours counter").

If a compressor stops due to an alarm, another compressor will immediately start.

7.4 Compressor delay times

The purpose of the programmable delay times that are used in the algorithm for the management of compressors and load steps is to ensure the compressors are in good working order, and to increase their lifespan.
When one of these delay times is active, the icon on the display corresponding to the delayed element flashes.
The managed times are:

CT0 - Minimum time between two ON of different compressors
This sets the minimum time that must elapse between two starts of different compressors, in order to reduce the peak of current drawn at power up.

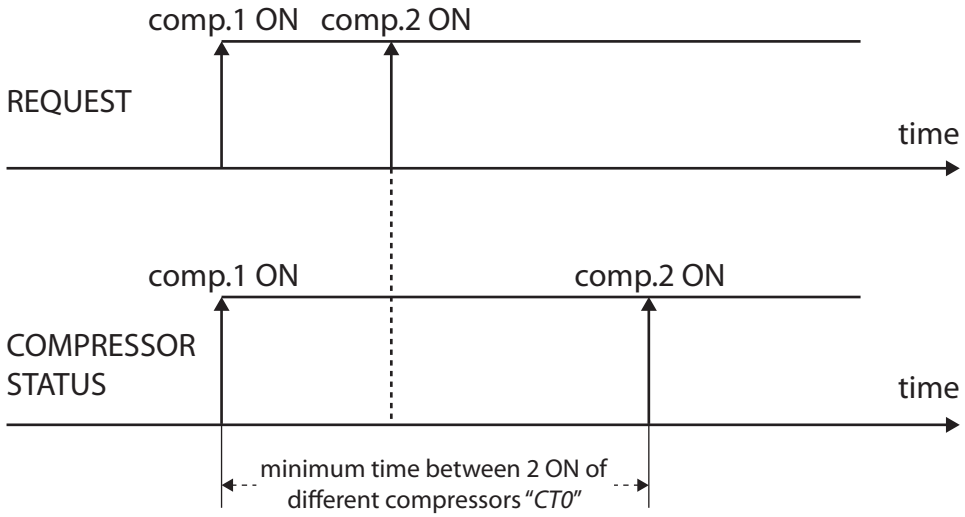


Fig 20 [Compressors - Delay times - CT0]

CT1 - Minimum time between two OFF of different compressors
This sets the minimum time that must elapse between two stops of different compressors, in order to reduce the number of stops per hour.

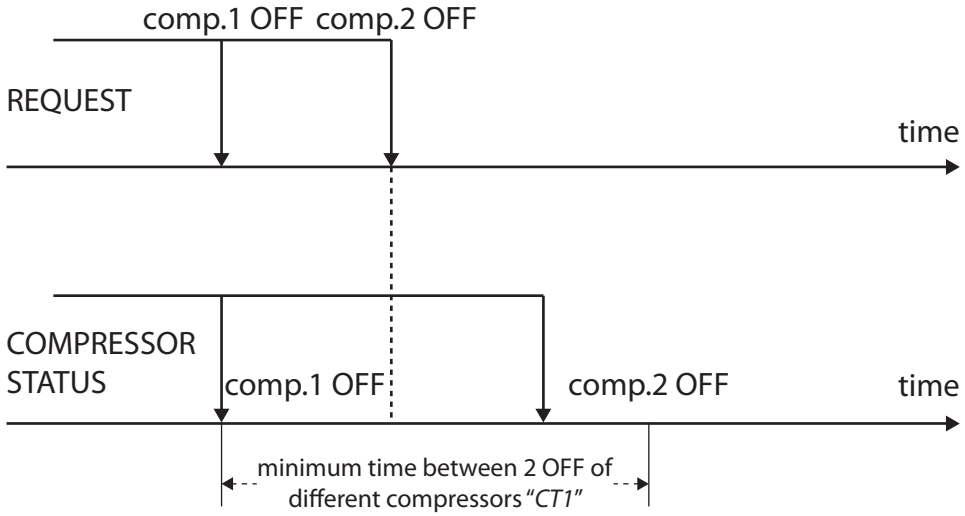


Fig 21 [Compressors - Delay times - CT1]

CT2 - Minimum OFF time
This sets the minimum OFF time of a compressor. A compressor will not be able to start until the configured minimum time since the last OFF has elapsed.

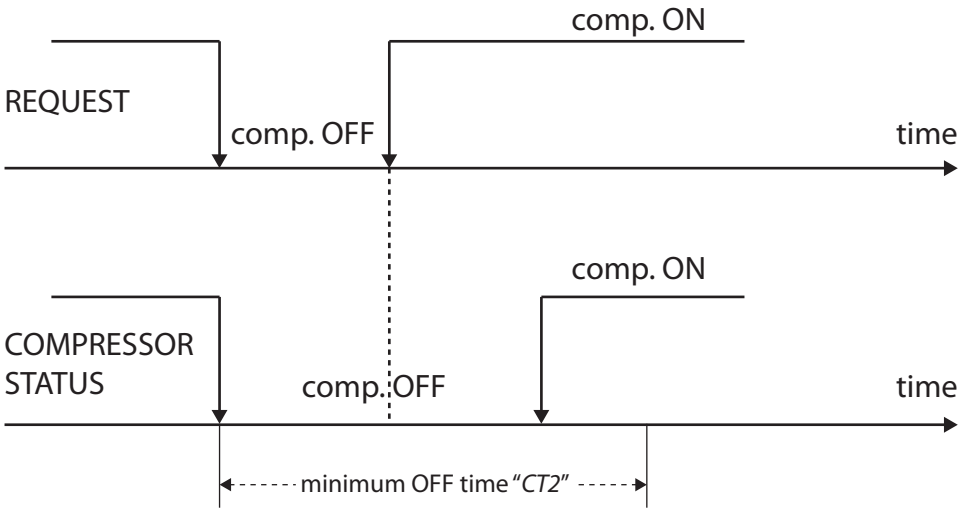


Fig 22 [Compressors - Delay times - CT2]

CT3 - Minimum ON time
This sets the minimum ON time of a compressor that, once activated, must stay ON for the configured time even if it is no longer requested. It is useful for avoiding lubrication problems, for instance.

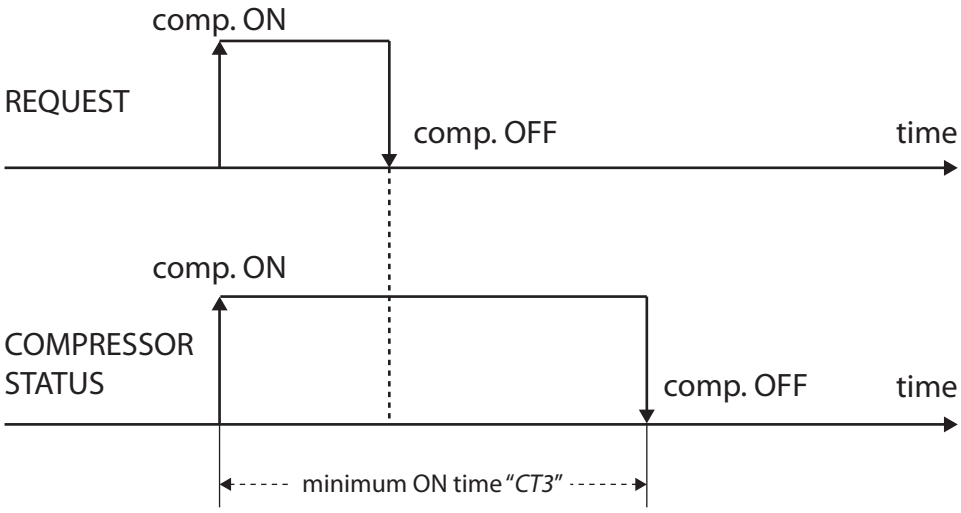


Fig 23 [Compressors - Delay times - CT3]

CT4 - Minimum time between two ON of the same compressor
This sets the minimum time that must elapse between two successive starts of the same compressor. This parameter allows the user to limit the number of compressor starts per hour. For instance, if the maximum number of permitted starts per hour allowed is equal to 10, it is enough to set "*CT4=360*" seconds (6 minutes) to guarantee the limit respect.
If by mistake it is lower than the sum of the minimum ON and OFF time, it will be ignored.

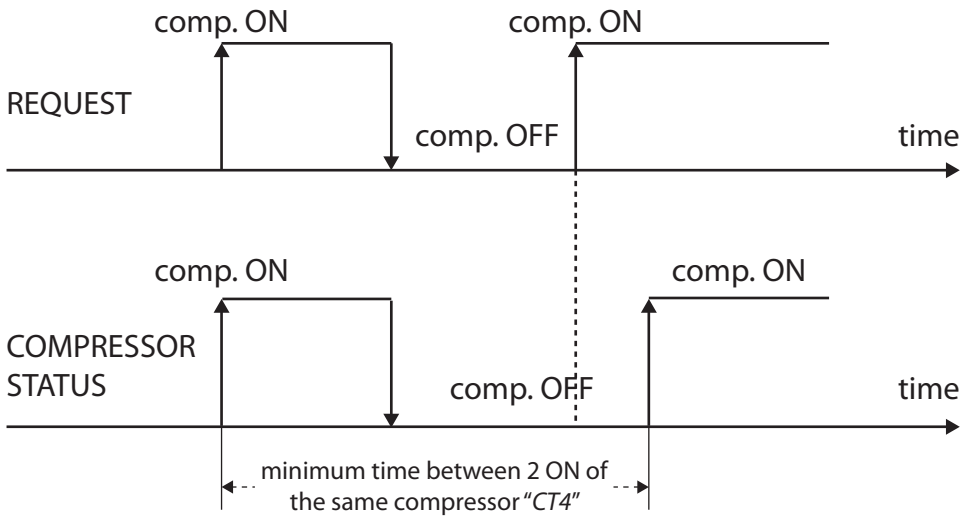


Fig 24 [Compressors - Delay times - CT4]

CT5 - Maximum gap between running hours
This sets the maximum ON time of a compressor, but is calculated from when there is another one OFF. The purpose to avoid a situation whereby one of the compressors could run more than the configured time while another one is OFF. When this time is elapsed, the running compressor is switched OFF even if it should continue to run and it is substituted by one of the compressors being previously OFF having the lowest number of running hours.
It only takes effect if the rotation type is based on running hours "*C01=tIME*".

CT6 - Delay from supply fan
The compressor start is enabled after the configured time from the activation of the water main pump (or supply fan).

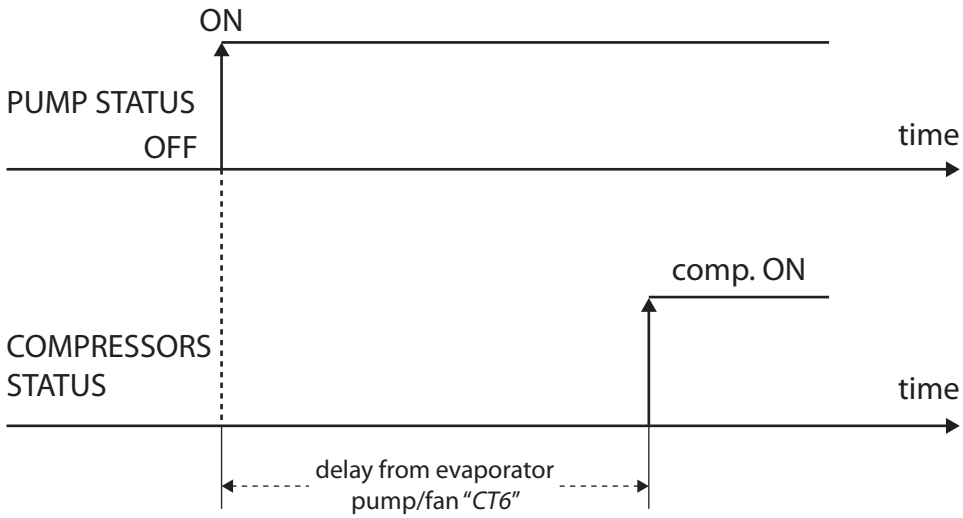


Fig 25 [Compressors - Delay times - CT6]

CT7- Minimum time between 2 ON unloader
This set the minimum time that the compressor must keep an unloader running before pass to another unloader.

7.5 Hours counters

To evaluate the compressor condition, the control monitors its run hours. The limit to be monitored is defined in "*W01*, ..., *W04*" per each compressor; if the compressor running time exceeds it, then the control will generate the warning "*W01*, ..., *W04*", indicating the need for compressor maintenance.

The run hours counters are accessible from the menu, (see 2.3.5 "Utilities").

7.6 Cold carter oil prevention

This function must be enabled from the "Functionalities" tab of the MCXShape configuration tool. Tick the "Enable cold compressor carter oil prevention" check box.

This function is used to guarantee the correct oil viscosity when the manufacturer has provided the unit with special heaters to warm up the oil in the carter.

If the function is activated in the unit configuration and the unit is not powered for a time greater than the parameter "*OL1*", then at the power ON, the compressors remain in the OFF position for a time equal to "*OL2*".
Rolling text on the LCD display shows the remaining time before start-up.

In this status the unit can be forced ON from the menu "*Uti-Utilities/Col-Carter Oil force ON*".

8.0 Liquid solenoid valve and pump-down

This function must be enabled from the "Functionalities" tab of the MCXShape configuration tool. Tick the "Enable pump-down" check box.

For the pump-down, the following is used:

- one digital output to drive one liquid solenoid valve for each circuit ("*Liquid Valve Circ1*", "*Liquid Valve Circ2*")
- one low pressure switch "LowPressure1, LowPressure2" or suction pressure transducer "*SuctionPressure C1*, *SuctionPressure C2*" for each circuit

8.1 Start-up

When the temperature control requires the first compressor of each circuit to start, this is the sequence:

- open the liquid valve
- wait until the start-up timer "*Pd2*" has elapsed or until suction pressure is above the initial start pressure setpoint "*Pd3*" (whatever comes first). This is to start before the suction pressure rises to a level where the gas turns into liquid
- start the first compressor

8.2 Pump-down

If the pump-down function is enabled (maximum time "*Pd1*" different from 0), when the temperature control requires the last compressor of the circuit to be OFF, the liquid valve is closed and the compressor keeps running. The compressor will stop for the following reasons:

- low pressure switch
- the suction pressure is below the pump-down pressure set at "*Pd4*"
- the pump-down maximum time "*Pd1*" is elapsed

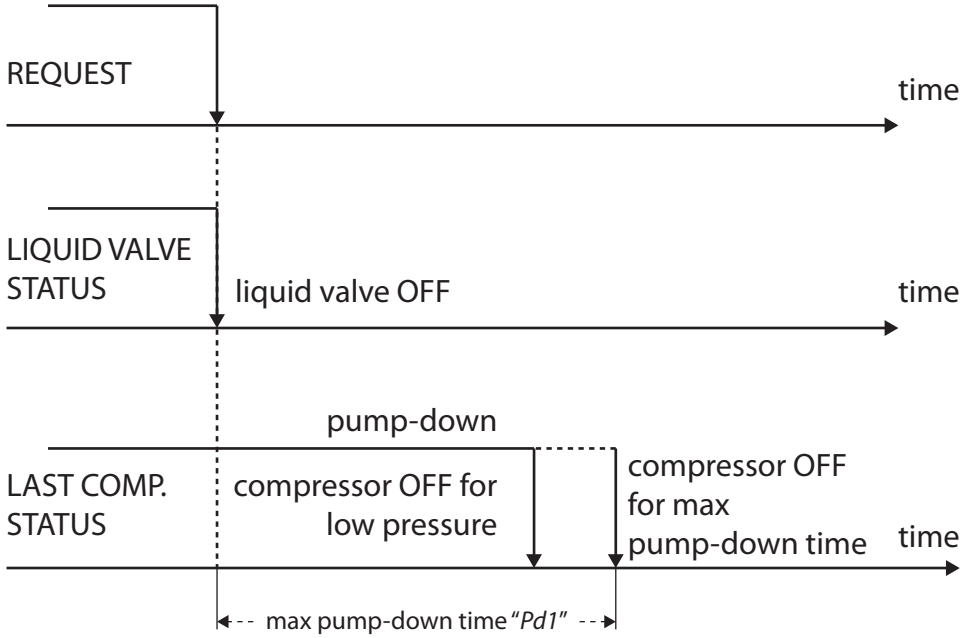


Fig 26 [Liquid solenoid valve and pump-down - Pump-down]

Note

1. *Pump-down is not executed when the unit is in OFF for alarm*
2. *If suction pressure signal is missing, the suction pressure criteria's will be ignored*

9.0 EEV (electronic expansion valve control)

9.1 EEV driver configuration

The software is able to manage external electronic expansion valve "*EEV*" drivers EXD316 and internal "*EEV*" drivers on MCX061V and MCX152V.

Note

"EEV" control must be enabled from the "Functionalities" tab of MCXShape configuration tool. Tick the "Enable expansion valve EXD316" check box.
Internal driver for superheat control must be enabled from the "Functionalities" tab of MCXShape configurator tool. Tick the "Enable valve driver configuration", "Use internal valve 1 -2 for superheat control" check box.

9.1.1 EXD316 configuration

The software manages 1 driver per circuit (maximum 2 circuits).

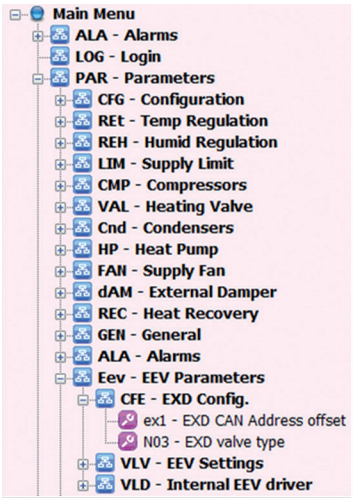


Fig 27 [EEV (electronic expansion valve control) - Main menu]

CAN Address
Through the "*ex1*" parameter, set the CAN address of the first connected EXD driver.
The "*ex1*" parameter is an offset referred to the MCX CAN address.

The CAN address of the second EXD drivers, if any, must be consecutive to the first one and without gaps.

Example

If "ex1=19" and MCX "address=1", then the addresses of the connected EXD must be:
- *"EXD#1=1+19=20"*
- *"EXD#2=EXD#1+1=21"*

Refer to the specific document on how to set the CAN address on the EXD drivers:

- if "*ex1*" is set to 0, no EXD driver is managed
- if "*ex1*" is different from 0 and there is no driver connected with the right address, an alarm is generated, (see 18 "Alarms")

We suggest setting "*ex1*" equal to 19 because 20 (19+1) is the default address of the EXD drivers.

Valve type
Through the "*N03*" parameter set the type of valve. For a description of parameters, (see "EXD316 user manual").

9.1.2 EEV configuration

All the parameters in common to the internal and external driver are grouped together in "*EEV Settings*"

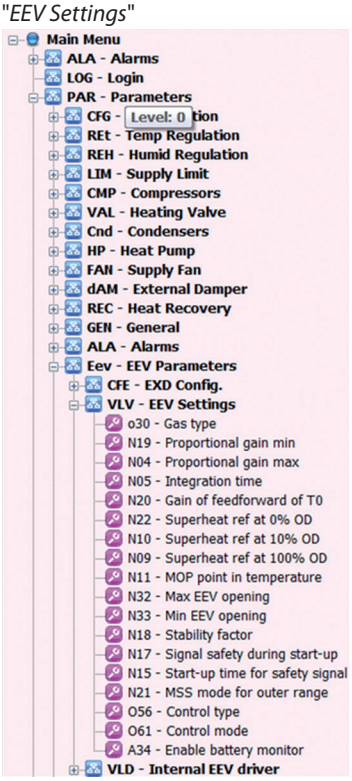


Fig 28 [EEV (electronic expansion valve control) - EEV configuration]

9.1.3 Internal driver configuration

The internal driver is present only on MCX061V and MCX152V. Besides enabling this functionality from the MCXShape configuration tool, the following conditions must be fulfilled to enable the management of the internal driver:

- the suction pressure and the suction temperature probes must be present;
- the "*EXV*" analog output must be configured on the output tab of MCXShape configuration tool ("*SH1 - SuperHeat Value1*") and/or ("*SH2 - SuperHeat Value2*").

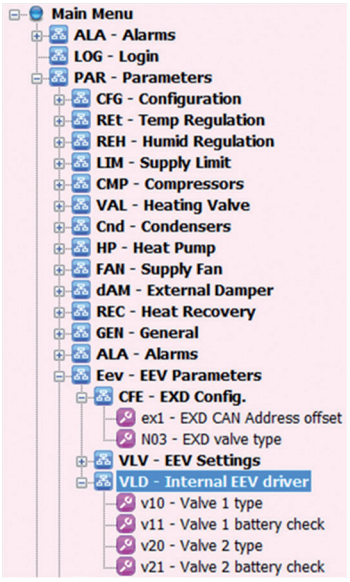


Fig 29 [EEV (electronic expansion valve control) - Internal driver configuration]

The parameters for defining the type of valve driven by the internal driver and the type of battery check are in the Internal "*EEV*" driver group.

9.2 EEV driver data access

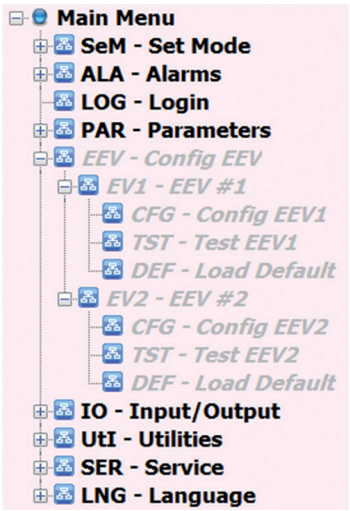


Fig 30 [EEV (electronic expansion valve control) - EEV driver data access]

Use menu "*EV1 - EEV #1*" and "*EV2 - EEV #2*" for accessing data from the first and second driver.

9.2.1 Configuration

Use sub-menu "*CFG – Config EEV1*" to access the parameters of the first "*EEV*" driver.

9.2.2 Test

Use the sub-menu "*tSt – Test EEV1*" to access the following data that is useful for testing the "*EEV*" driver.

Fig 31 [EEV (electronic expansion valve control) - Test]

ValvePos: valve opening degree

S2: value of "*S2*" temperature sensor at evaporator outlet

S4: value of "*S4*" temperature sensor for measuring air temperature

AI: value of external reference

DI: status of ON/OFF digital input

SH: superheat

SHR: superheat reference

Pe: evaporating pressure

Te: evaporating temperature

Alr: alarm status; one bit for each alarm from left to right, (see "EXD316 user manual"):

- fault in controller
- "*S2*" sensor error
- "*S4*" sensor error
- the input signal on terminals 17-19 is outside the range
- the input signal on terminals 21-22 is outside the range
- no refrigerant has been selected
- check the supply voltage to the step motor
- battery alarm
- CAN driver

- Press the key to go to manual mode
- Use the and keys to set the valve opening degree
- Press the key to go back to automatic mode

9.2.3 Default parameters

Use the sub-menu: "*DEF - Load Default*" to load the factory parameters on the selected EEV driver.

If the use of an internal driver for superheat control is enabled, then the default parameter values that are loaded are those defined in the MCXShape configuration tool.
Otherwise, the default values are the factory values of EXD316, (see "EXD316 user manual").

10.0 Input and output expansion

The software is able to manage one of the following input and output expansions:

- EXC06D
- MCX08M
- MCX15B
- MCX20B

The selected expansion must be configured with the MCXShape configuration tool.

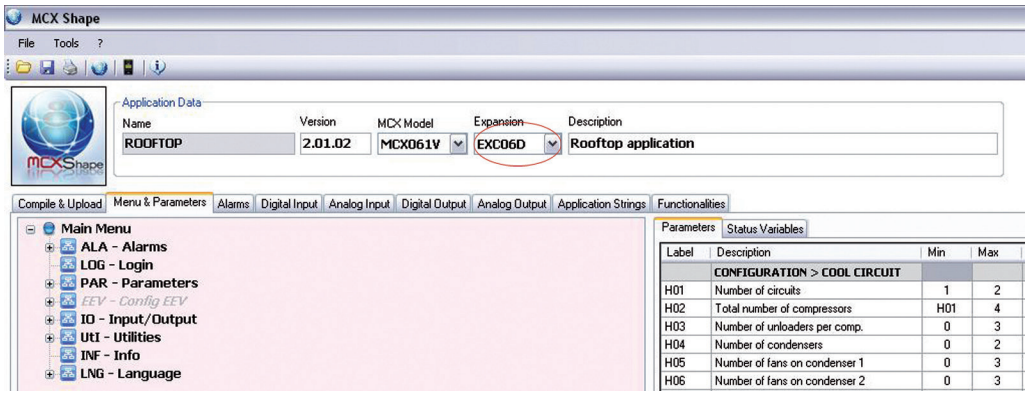


Fig 32 [Input and output expansion - Configuration]

10.1 Connection

Through the "*XCn*" parameter, set the connected CAN address of the input and output expansion.

The "*XCn*" parameter is an offset referred to as the CAN address of the MCX.

10.2 Input and output definition

In the input and output tabs of the MCXShape configuration tool, the expansion's input and output are highlighted in a different colour (yellow) from those on the MCX.

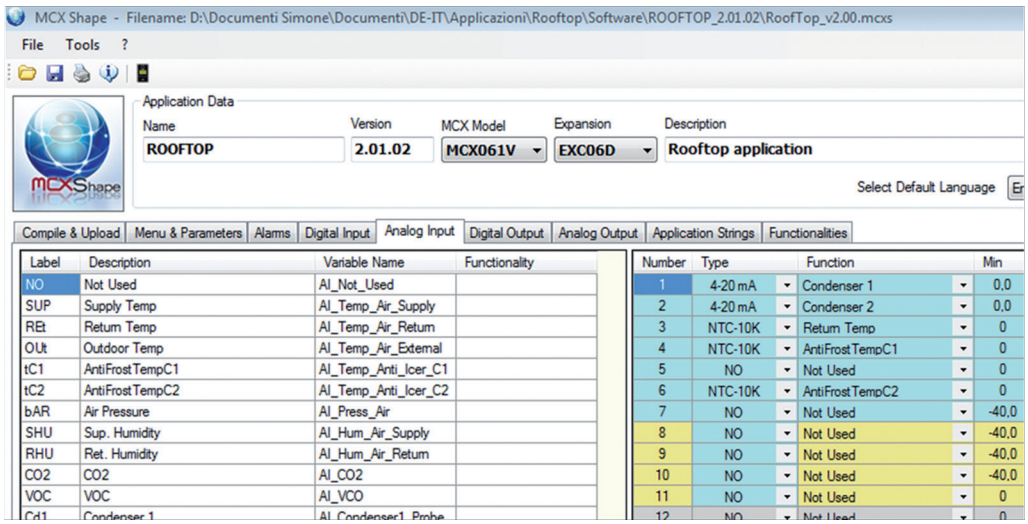


Fig 33 [Input and output expansion - Input and output definition]

11.0 Heat pump

11.1 Reversing valve

For the choice between heating and cooling, (see 4.2 "Choice of control modes").

According to that selection, the "*Reverse Valve*" digital output, driving the reversing valve of each circuit, is opportunely controlled. The output working logic between Normally Close (N.C.) and Normally Open (N.O.) is defined with the MCXShape configuration tool.
If polarity is set to "*Open*" it means that relay is energized in heating mode.

Times for cycle reversing are defined by the "*d00*" parameter (Changeover delay) that forces compressors OFF before cycle reversion. This time is calculated since the last compressor is OFF. This time is waited also after the valve reversion before turning ON compressors again.
If it is equal to 0, compressors are not stopped and the reversing valve is immediately reversed.

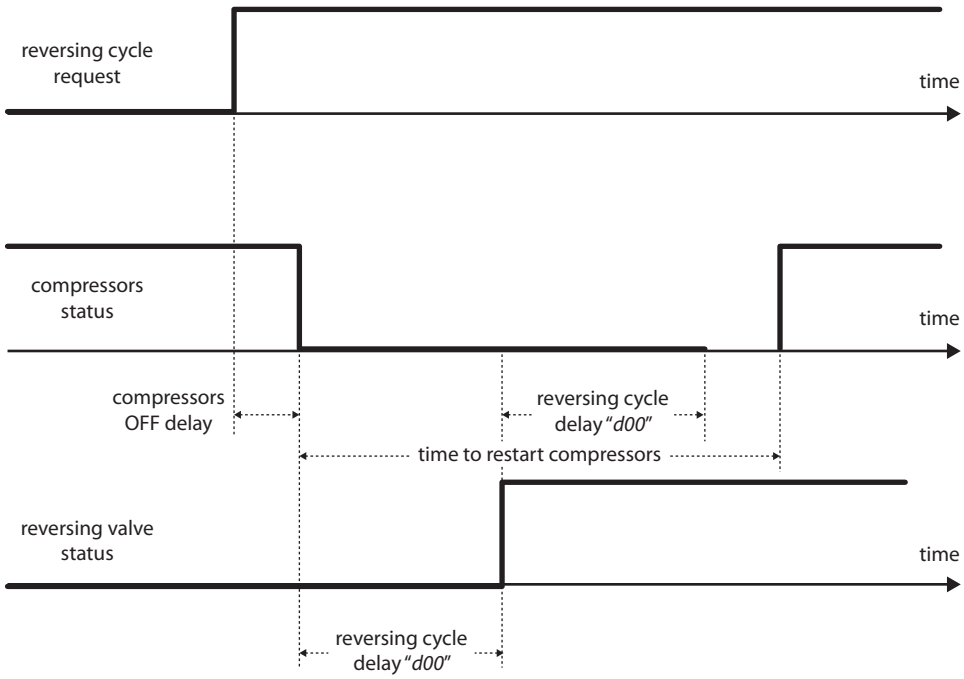


Fig 34 [Heat pump - Reversing valve]

11.2 Defrost

11.2.1 Description

With air cooled heat pumps it is possible to activate the defrosting procedure of the outdoor heat exchanger in heating mode (evaporator).

Defrost can be executed if enabled through "*d01*", the unit is in heating mode, at least one compressor is turned ON and the condensing probe (pressure or temperature) "*Cd1 - Condenser 1*", "*Cd2 - Condenser 2*" or the "*DEF - Defrost*" digital input is present.

Defrost is signaled by turning ON the corresponding icon on the display and can be executed in the following two ways:

1. Reversing the cycle of the involved circuit, in this case:
    - cycle is reversed through a 4-ways valve
    - the system cooling power is brought is at maximum
    - the way of working of the involved fan is managed by "*d05*" parameter
2. If the outdoor temperature allows (parameter "*d06 - Fan only defrost*"), defrost can only be performed by turning OFF compressors and turning ON fans at their maximum speed

Defrost is prior to the compressors timers. Compressors timers are thus ignored while defrosting and compressors ON and OFF are immediate. However to avoid contemporaneous activations and to ensure a gradual insertion of the cooling power, only the minimum time between the activation of two compressors "*CT0*" is respected.

On multi-circuit systems, each circuit is independent and starts defrosting when it is necessary.

Defrost digital input
If "*d22=Yes*", the "*Defrost*" digital input can be used to start defrost.
The input logic is defined with the MCXShape configuration tool.
If polarity is set to "*Close*" it means that the input is active when open.
When the contact is active, it forces the defrost start and it stops according to the method selected with "*d02*". When the contact is inactive, the defrost start or stops according to "*d02*".

11.2.2 Parameters for defrost control

Defrost is configured with the following parameters.

d01 – Defrost enable
Defrost is enabled.

d02 - Defrost type
This allows the user to select the method of starting and stopping defrost from between:

- "*d02=SpEp*" (Start on Probe End on Probe) start and stop on the basis of the value measured by the temperature or pressure probe "*Condenser 1*", "*Condenser 2*" used for controlling the outdoor heat exchanger.
  Defrost starts when the temperature or pressure goes under a defined limit "*d09*" for a cumulative time defined in "*d13 - Defrost start verifying time*", (see the following figure)
  Defrost is stopped when the temperature or pressure goes beyond a second limit "*d10*" or if the defrost probe is defective.
- "*d02=SpEt*" (Start on Probe End on Time) as before but defrost stops only after the defrost maximum time "*d15*" has elapsed

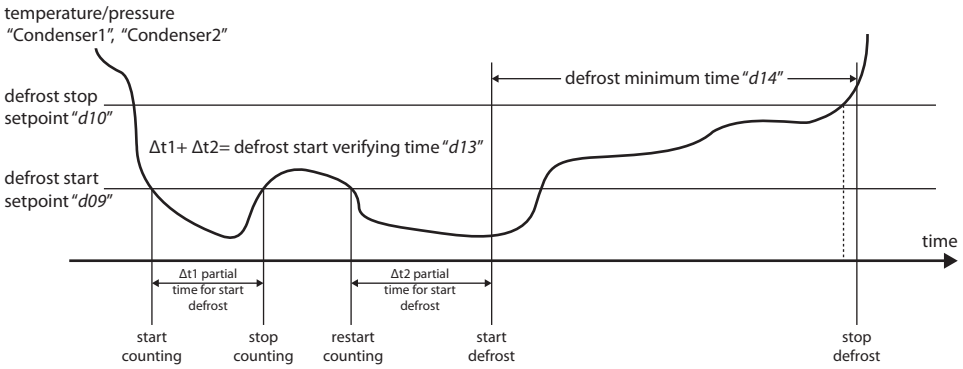


Fig 35 [Heat pump - Parameters for defrost control - d02]

d04 - Heaters ON while defrosting
"*d04=YES*" states that heaters have to be activated while defrosting to reduce the cold blow effect.

d05 - Fan management while defrosting
This defines the way fans on external heat exchanger are managed while defrosting.
The following choices are available:

- "*d05=OFF*" fans are always OFF
- "*d05=EqUA*" fans are managed as in cooling mode
- "*d05=ONdr*" fans are OFF until the stop defrost condition; after that the fans are turned ON at their maximum speed for the "*d20*" time, the waiting time after defrosting (dripping time). After this time has elapsed, the cycle goes back to the heating mode and to its normal fan management

Note

If the unit is in Fan Defrost mode, (see "d06" parameter), for fan management.

d06 - Fan only defrost
This function allows the user to take advantage of the outdoor temperature "*OutdoorTemp*" when it is adequate to defrost the outdoor coil.
In this mode, the unit turns OFF compressors and drives fans at their maximum speed, without reversing the cycle.
Defrost start and stop conditions and the support heaters management remain unchanged, as described above.
If "*d06=0*", the function is disabled. Otherwise it represents the minimum outdoor temperature to be reached for enabling the function.
Fan defrost will then be executed when the start defrost condition is verified.

d07 – Enable low pressure alarm during defrost
It allows you to disable "*d07=NO*" the low pressure switch control during the whole defrost cycle.

d09 - Defrost start setpoint
d10 –Defrost stop setpoint
(See parameter "*d02*").

d13 - Defrost start verifying time
This sets the time during which the condensing temperature/pressure must stay under the defrost start setpoint "*d09*" to activate defrost. Counting is stopped but it is not reset when the temperature/pressure goes beyond the limit "*d09*". The counter is is reset at power ON or when the defrost cycle starts.

d14 - Defrost minimum time
If this time has not elapsed, defrost goes on even if the stop defrost condition is already reached.
It is ignored in the case of defrost from a digital input.

d15 - Defrost maximum time
If the time ended defrost is enabled "*d02=spEt*", it sets the defrost endurance.
Otherwise it represents its maximum endurance, beyond which defrost is stopped and the "*A13*" warning occurs. This warning is reset after a correct defrost cycle.

d16 - Minimum time between two defrost cycles
This is the minimum delay between the end of one defrost cycle and the start of the following one.
If it is not higher than "*d13*", defrost start verifying time, it is ignored.
It is also ignored in the case of defrost from digital input.

d20 - Waiting time after defrosting
At the end of the defrost cycle, the compressor is stopped for all this time if it is higher than double that of the changeover delay "*rE1*", (see the following figure); otherwise the last one is valid.
The 4-ways valve is reversed anyhow after the changeover delay; this delay allows pressures equalisation after the defrost cycle and an eventual dripping of the outdoor heat exchanger, (see "*d05*" for fans management during this phase).

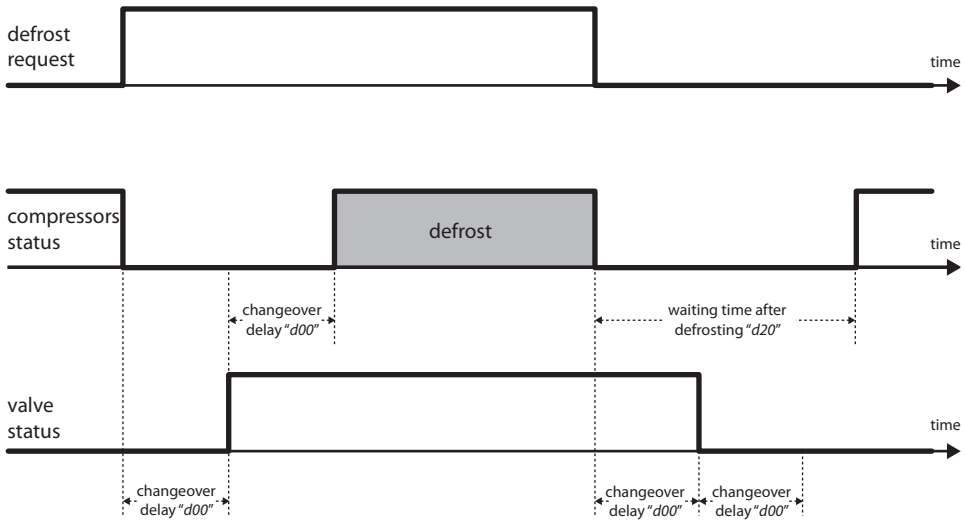


Fig 36 [Heat pump - Parameters for defrost control - d20]

d21 - Fan offset in dripping time
In order to keep the battery warm during the waiting time after defrost "*d20*" (dripping time) the offset "*d21*" is added to the condenser summer setpoint "*c1A*" and "*c2A*".

d22 - External defrost control
When the condenser probe is not present, the defrost can be started and stopped by using the digital input "*DEF - Defrost*".

12.0 Condensers

12.1 Configuration

The algorithm manages up to two independent condensers (parameter "*H04 - Number of condensers*"). For how to set parameters related to the configuration of condensers,
(see 3.2.1 "Cooling circuit configuration").

In AIR condensed units, condensation is regulated by managing the fans on the condensing coils.

On the other hand, in "*WATER*" condensed units, condensation is achieved by managing the water circulation pumps on the condensation circuit.

Below we will only refer to the parameters for one condenser given that those for the second condenser are identical.

12.2 Control

C1M, C2M - Regulation mode
Condensation can be regulated according to what is defined in "*C1M*" and "*C2M*" in the following ways:

- **OFF** No regulation
- **ON** Fans always on at their maximum speed. They are only turned OFF when the machine is in stand by mode
- **ONC** Regulation linked to operation of the compressors.
  The fans operate in ON/OFF mode and operation is subordinate only to operation of the compressors: the fans are ON and run at full speed when at least one of the circuit compressors is active.
  All compressors "*OFF=fan*" OFF.
  At least one compressor "*ON=fan*" ON
- **REG and REGC** Regulation linked to pressure or temperature sensor.
  Operation of the fans is subordinate to the readings on the "*Condenser 1*" and "*Condenser 2*" pressure or temperature sensors arranged to regulate condensation respectively of the first and second circuit and can also be subordinated to any compressor operation. If "*C1M*, *C2M=REGC*" when compressors are OFF, fans are also deactivated, independently from the value of the condensing pressure/temperature

Note

If there is only one condenser "H04=1" for two circuits "H01=2", the fans are operated according to the highest circuit pressure/temperature in cooling and to the lowest in heating; on the other hand, with separate condensers, each pressure/temperature sensor controls its own fan or group of fans.

Regulation can be performed in steps or through modulation.

12.2.1 Step control in cooling

Hereinafter we will only refer to regulation of the first condenser, since that of the second condenser is identical.

The fans are operated in ON/OFF mode according to a setpoint "*c1A*" and a band or differential "*c1B*": this band is divided equally among the fans.

The temperature or pressure can be used to regulate condensation depending on the type of "*Condenser 1*" input defined with MCXShape configuration tool.

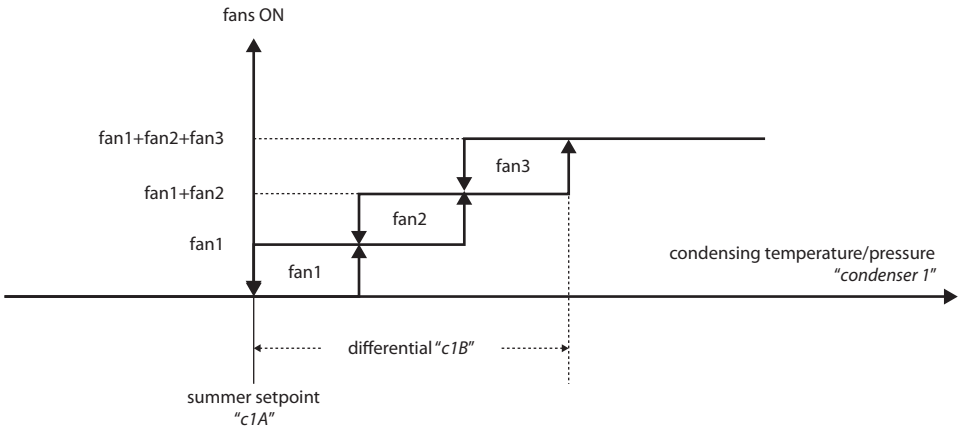


Fig 37 [Heat pump - Step control in cooling]

- With the pressure/temperature value lower than or equal to the setpoint, all fans are OFF.
- With the pressure/temperature value greater than the setpoint + differential, all fans are ON.

12.2.2 Modulating control in cooling

If enabled with the parameters "*c10*" and "*c20*", the group of fans on each condenser are controlled by an analog output 0/10 V or PWM/PPM (with impulse width/position modulation synchronous with the line) proportional to the demand from the pressure/temperature sensors which control an external inverter or cutting phase device, respectively. For simplicity, hereinafter we will only refer to inverter regulation.

The analog outputs "*Condenser1*" and "*Condenser2*" are used to run the inverter and the associated digital output "*Cond1 Inverter*", "*Cond2 Inverter*" is used for the inverter's ON/OFF function.

The number of analog/digital outputs used is equal to the number of condensers.

Hereinafter we will only refer to regulation for condensation of the first condenser, since that of the second condenser is identical.

Condenser 1
The percentage values corresponding to the minimum and maximum inverter speed are defined with "*c11*" and "*c12*"; within these values, the proportional output modulation action is calculated as described in the figure.

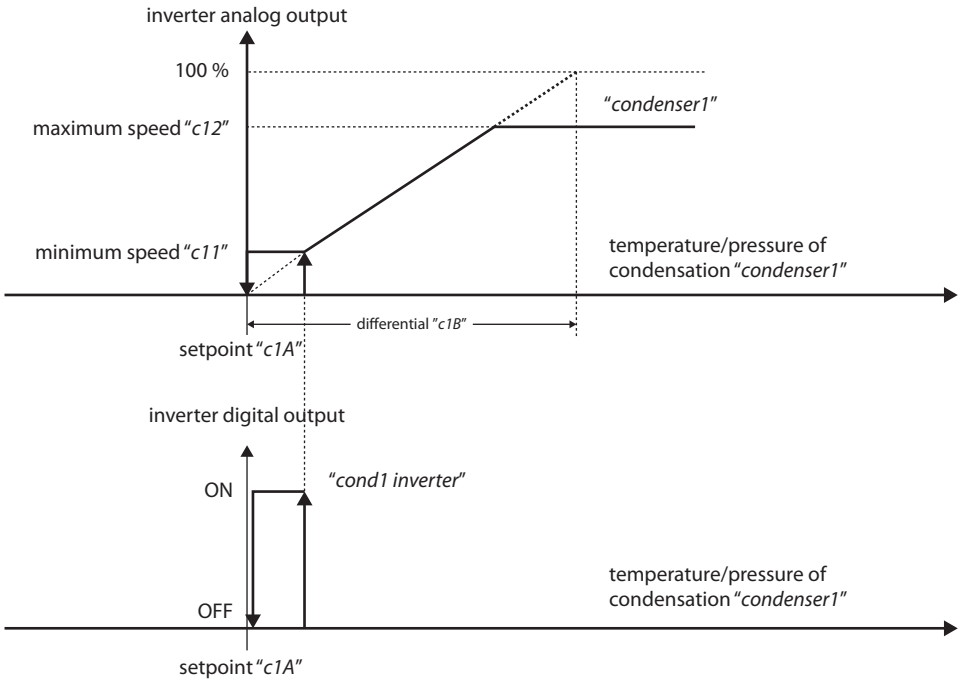


Fig 38 [Heat pump - Modulating regulation in cooling]

The setpoint for inverter regulation is the same as that used for step regulation.

The inverter output is activated when the demand is equal to or greater than the capacity that can be obtained with the inverter at its minimum speed.

In the case of cutting phase regulation through an external module, the impulse duration "*c14*" has to be set up, which has to be applied to the triac.

The inverter minimum ON time is defined in "*c15*". Until this time expires, the inverter stays at its minimum speed even if it is requested to be OFF.

12.2.3 Control in heating

The management of fans in heating mode is analogous and a mirror image of the one in cooling mode. Fans are activated when the temperature of the external heat exchanger decreases.

All the related parameters are then duplicated, i.e. the setpoint "*c1C*", differential "*c1D*" for control in heating.

12.3 Condensation probe failure

If the probe used to control condensation fails, the effect of the alarm on the condensation fans is defined with "*c1E*" as follows:

- **OFF** fans always OFF
- **COMP** fans ON if the compressor (or compressor inverter) is ON
- **ON** fans always ON

12.4 Hours counters

To evaluate the fan condition, the control monitors its run hours. The limit to be monitored is defined in "*W05*, ..., *W10*" per each fan; if the fan running time exceeds it, then the control will generate the warning "*W05*, ..., *W10*", indicating the need for fan maintenance.

It is possible to access the hours counters from the menu, (see 2.3.5 "Utilities").

13.0 Controlling the supply temperature limits

13.1 Supply temperature lower limit

This function protects the environment and the people therein from an infeed of air that is too cold.

The function is enabled with "*Lt1*" and requires setting the lower limit "*Lt2*" below which the supply temperature must not drop.

Operation in cooling mode
When the supply temperature "*SUP - Supply Temp*" drops below the lower limit "*Lt2*" increased by band "*Lt3*", the cooling devices (compressors and free cooling dampers) are limited proportionally to how much the supply temperature differs from the limit setpoint.
Below the setpoint, the limitation is total.

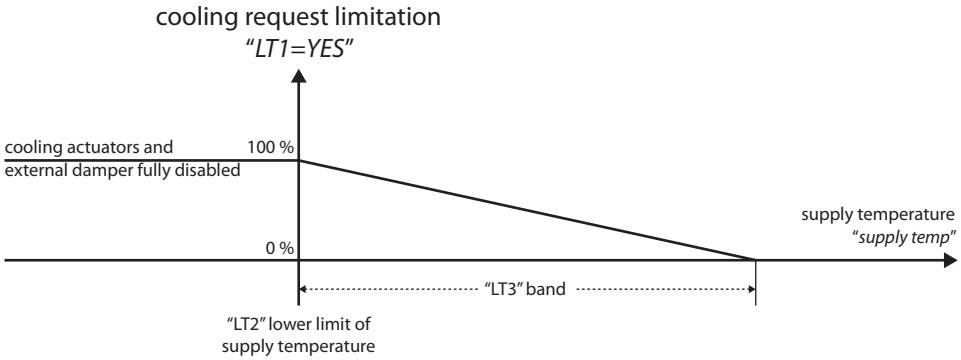


Fig 39 [Controlling the supply temperature limits - Operation in cooling mode]

Operation in dehumidification mode
Limitation is ON/OFF as described in the figure.

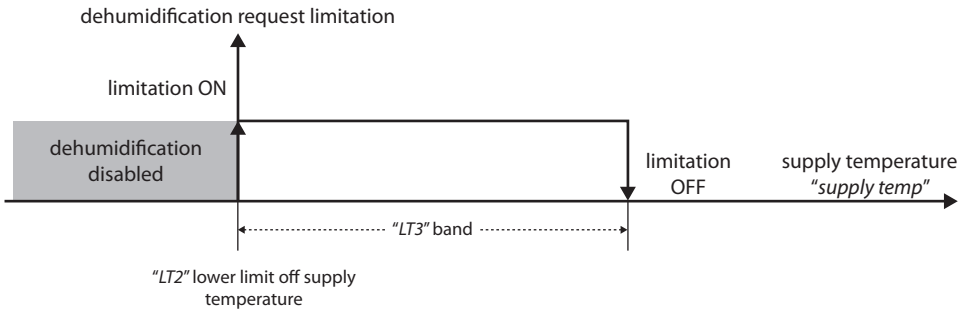


Fig 40 [Controlling the supply temperature limits - Operation in dehumidification mode]

13.2 Supply temperature upper limit

This function protects the environment and the people therein from an infeed of air that is too hot.

The function is enabled with "*Lt4*" and requires setting the upper limit "*Lt5*" above which the supply temperature must not rise.

The behaviour mirrors what follows for the lower supply limit. When the supply temperature "*SUP - Supply Temp*" rises above the upper limit "*Lt5*" decreased by band "*Lt6*", the heating device and any damper to feed in outside air (free heating) are limited proportionally to how much the supply temperature differs from the limit setpoint.
Above the setpoint, the limitation is total.

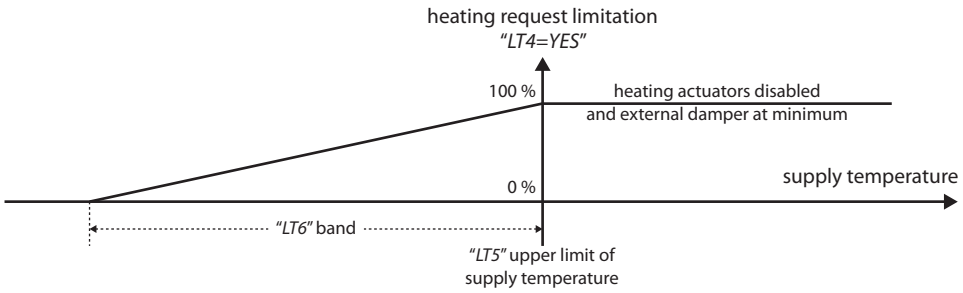


Fig 41 [Controlling the supply temperature limits - Supply temperature upper limit]

14.0 Humidity control

Parameter "*U01*" is used to enable humidity control and defines the probe used for control:

- if "*U01=SUP*", the probe used is the supply humidity "*SHU – Sup. Humidity*"
- if "*U01=REt*", the probe used is the return humidity "*RHU – Ret. Humidity*"

14.1 Humidification control

The software can handle both ON/OFF and modulating humidifiers, respectively using the digital output and the analog output "*HUM - Humidifier*".

The humidifier is controlled by the return humidity probe "*U01=RHU*" or the supply humidity probe "*U01=SHU*" with proportional logic based on the following parameters:
setpoint "*U03*", neutral zone "*U04*" and differential "*U05*".

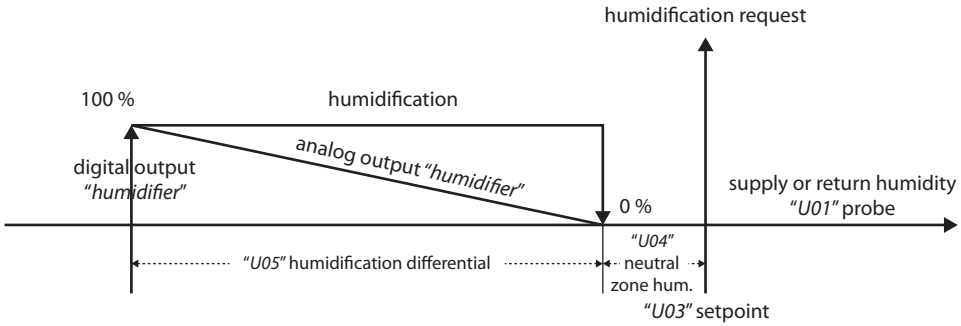


Fig 42 [Humidity control - Humidification control]

14.2 Dehumidification control

Dehumidification is achieved by running the cooling coil at 100% or with the digital output "**dEU** - *Dehumidifier*".

The parameter "*U01*" is used to enable humidity control and defines the probe used for control.

Then the humidity setpoint is defined in "*U03*" along with a neutral zone lateral to the setpoint in "*U06*" and the differential in "*U07*".

The humidity control is proportional only.

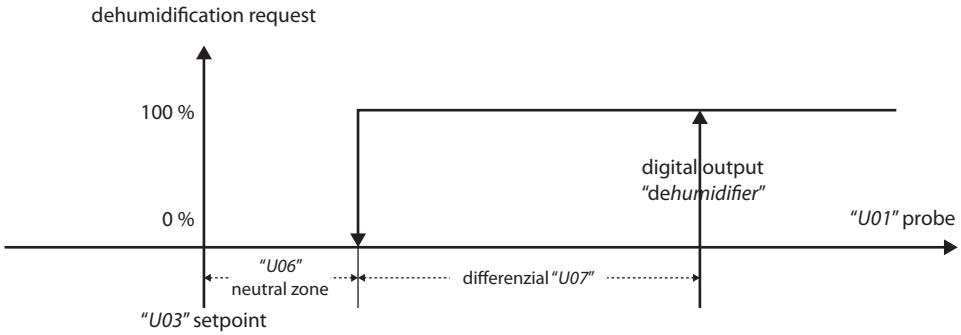


Fig 43 [Humidity control - Dehumidification control]

The priority between temperature and humidity control is defined by parameter "*U02*".

If "*U02*" is different from NO, then:

- "*U02=tEM*" temperature has priority: if it is necessary to both heat and dehumidify, the heating request prevails and dehumidification will only be performed when the heating phase has terminated
- "*U02=HUM*" humidity has priority: in the case indicated above, dehumidification prevails and heating will be performed after the dehumidification phase has terminated
- "*U02=NO*" then reheating in dehumidification is enabled, (see 6.0 "Heating control")

14.3 Controlling the supply humidity limits

Upper limit
Control of the upper limit for supply humidity prevents the onset of condensation in the supply ducts.

The function is enabled with "*LH4*" and requires setting the upper limit "*LH5*" above which the supply humidity must not rise and the limit band "*LH6*".

In the case of a modulating humidifier, as the supply humidity reaches the upper threshold "*LH5 - LH6*", the controller limits the output to the humidifier proportionally to how much the supply temperature differs from the setpoint limit. If the unit has an ON/OFF humidifier, it is turned OFF directly by the threshold limit and reactivated after the differential "*LH6*" is reached.

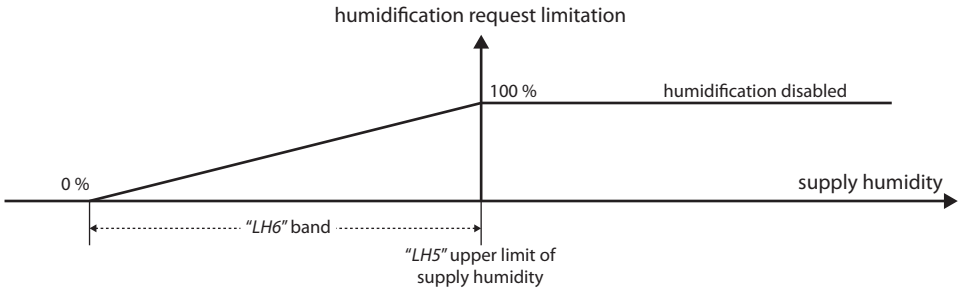


Fig 44 [Humidity control - Upper limit]

Lower limit
This function protects the environment and the people therein from an infeed of air that is too dry.

The function is enabled with "*LH1*" and requires setting the lower limit "*LH2*" below which the supply temperature must not drop and the limit band "*LH3*".

The behaviour mirrors what follows for the upper supply limit but limitation is of the ON/OFF type.

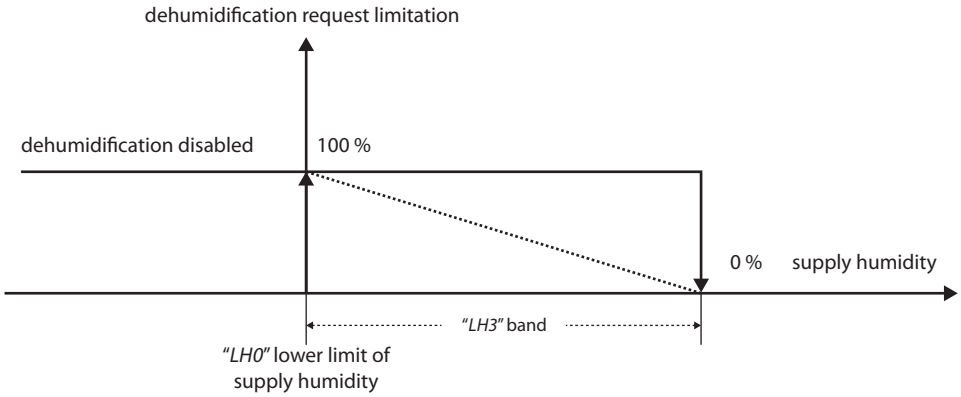


Fig 45 [Humidity control - Lower limit]

15.0 Supply fan and damper

The fan only runs if its damper is open.
The supply damper opens at start-up and after the "*SF4*" time the supply fan is allowed to start.
The supply fan stops after the "*SF5*" time from the OFF request.
If the supply fan is not running, control is stopped.
The supply damper closes after the "*SF5*" time from the compressors' OFF.

15.1 Type and presence of supply fan

The parameters used to set the type of fan and the way it is controlled are as follows:

F00 – Regulation type

- If "*F00=ONOF*" the fan starts when the unit is turned ON (after delay time "*SF4*" has elapsed) and always remains on except in the case of fire. The fan is controlled using the digital output "*SUF - Supply Fan*"
- If "*F00=REQ*" the fan is only activated when temperature or humidity control action is requested.
  The following three digital outputs are used to control the fan; they have been conceived to run a fan with a star-delta connection arranged for two operating speeds:
  - "*SUF - Supply Fan*" is activated when a control action is requested (line contactor)
  - "*SFL - SupplyFanLow*" is activated as indicated in the figure (star contactor)
  - "*SFH - SupplyFanHigh*" is activated as indicated in the figure (delta contactor)

  Then the analog output "SUF - Supply Fan" is used to control the fan; it is activated in a manner proportional to the demand

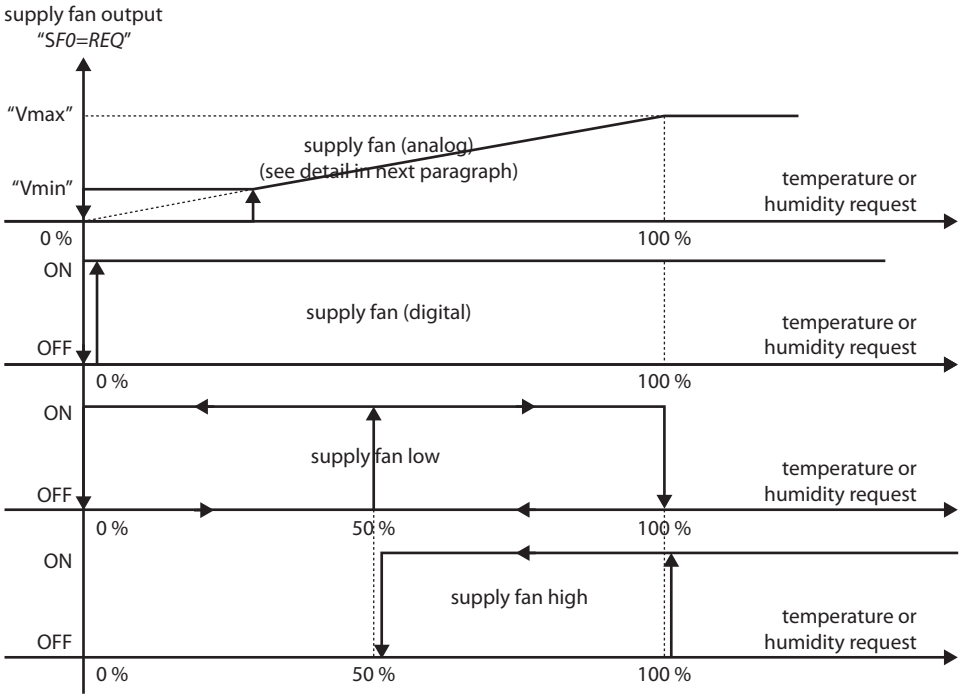


Fig 46 [Supply fan and damper - F00 type of fans]

- If "*F00=PID*" the fan modulates its speed with "*PID*" control (parameters "*Fr3 - Fr6*") according to a setpoint "*Fr2*" and the value of a reference probe, defined by "*F01*" from among the return temperature "*F01=REt*", supply temperature "*F01=SUP*" and air pressure "*bAR - Air Pressure*" ("*F01=bAR*") probes.
  The control type is defined in "*Fr1*" from among the following possibilities:
  - "*Fr1=INV*" inverse control, e.g. heating
  - "*Fr1=DIR*" direct control, e.g. cooling
  - "*Fr1=Co1*" direct or inverse control according to the operating mode: summer/winter = direct in summer, inverse in winter
  - "*Fr1=Co2*" direct or inverse control according to the operating mode: summer/winter = inverse in summer, direct in winter

The outputs indicated in the previous point are used to control the fan.
In case of a reference probe failure, the fan is forced to function at its maximum speed.

15.2 Fan speed configuration

In the case of "*F00=REQ*" and "*F00=PID*" control, the fan speed configuration parameters are described in the figure below.

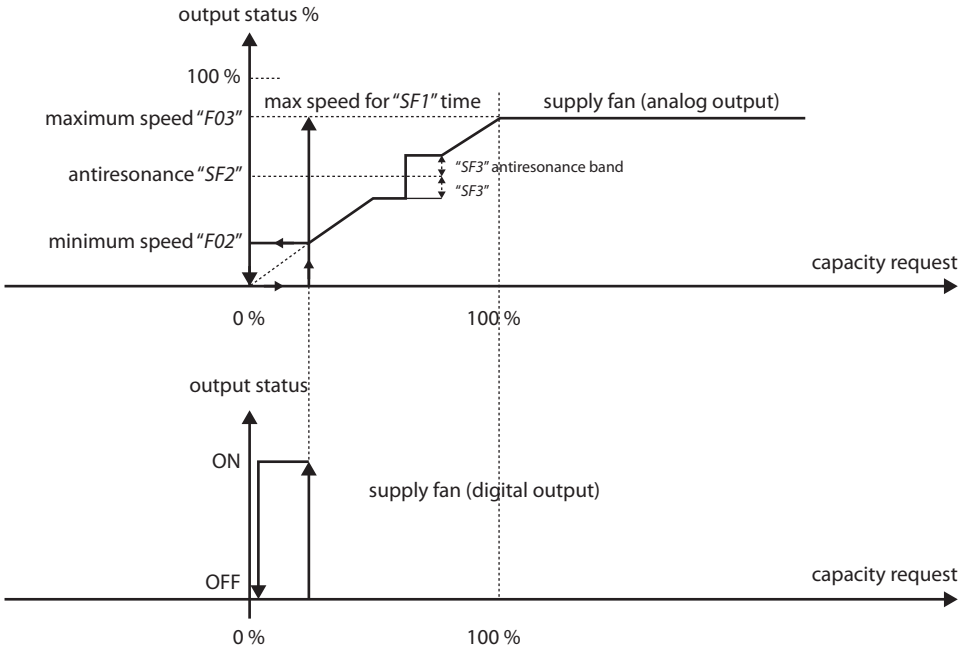


Fig 47 [Supply fan and damper - Fan speed configuration]

The percentage values corresponding to the minimum and maximum fan speeds are defined with "*F02*" and "*F03*"; within these values, the modulation output action is calculated as described in the figure. The fan output is activated when the demand is equal to or greater than the capacity which can be obtained with the fan at minimum speed.

The starting speed is the minimum rate if "*SF1=0*"; otherwise "*SF1*" defines the starting breakaway time during which the fan runs at maximum speed "*F03*".
In "*SF2*" it is possible to define a percentage speed you wish to avoid because it corresponds to the resonance frequency. In this case, the fan will avoid speeds that fall between "*SF2 - SF3*" and "*SF2*" + "*SF3*", as described in the figure.

Note

To ensure that coils are not working while the fan is not running, the coil power is limited to zero until the fan is able to start at its minimum speed.

15.3 Hours counters

To evaluate the supply fan condition, the control monitors its run hours. The limit to be monitored is defined in "*W11*"; if the fan running time exceeds it, then the control will generate the warning "*W11*", indicating the need for fan maintenance.

It is possible to access the run hours counters from the menu, (see 2.3.5 "Utilities").

16.0 External damper and free cooling

The external damper is controlled to achieve the following functions:

- **free cooling and free heating** — this function uses outside air to cool or to heat when the environmental conditions are favourable
- **air quality control** — this function involves an air changeover created by feeding in outside air and is based on the values of the "*CO2*" and volatile particles "*VOC*" in the environment or is performed at set intervals

When there is no request to open the damper for free cooling/free heating, or for air quality control, the damper is positioned at the minimum opening "*dE1*".

The external damper is controlled by the digital output "*ESH - External Damper*" if it is an ON/OFF type or with the analog output "*ESR - External Damper*", if it is a modulating unit,
(see 3.2.4 "Dampers configuration").

In the case of digital output, it is activated when the request is above 50% and it is deactivated when the request is less than or equal to 50%.

In the case of a modulating unit, the degree of opening is equal to the request as long as it is greater than the minimum opening set in "*dE1*".

The free cooling/free heating control can be based on temperature or enthalpy according to what is defined with the parameter "*dE0-FreeCoolHeating*" Type.

If "*dE0=NO*" the external damper is only driven by air quality control.

16.1 Temperature free cooling/ free heating "dE0=Tem"

16.1.1 Summer freecooling

As shown in the figure below, the opening of the external damper is controlled by the probe defined with "*FC5*" between the return air temperature "*REt - Return Temp*" or the "*OUt - Outdoor Air Temperature*" as long as the following conditions are met:

- the unit is running in summer mode
- the summer free cooling function is enabled "*FC0=YES*"
- the outside air is cold enough vs. the room temperature, in other words if:
  outside temperature ("*OUt - Outdoor Temp*") < return temperature ("*REt - Return Temp*") - free cooling delta "*FC4*".
  Free cooling is disabled when the outside temperature becomes greater than the return temperature

The free cooling differential "*FC2*" is used to define the damper modulation range.

An offset "*FC1*" is used to establish the position of the modulation band vs. the active temperature setpoint: damper setpoint=summer setpoint "*R02*" + offset "*FC1*".
With a positive offset, free cooling is activated after the summer setpoint.

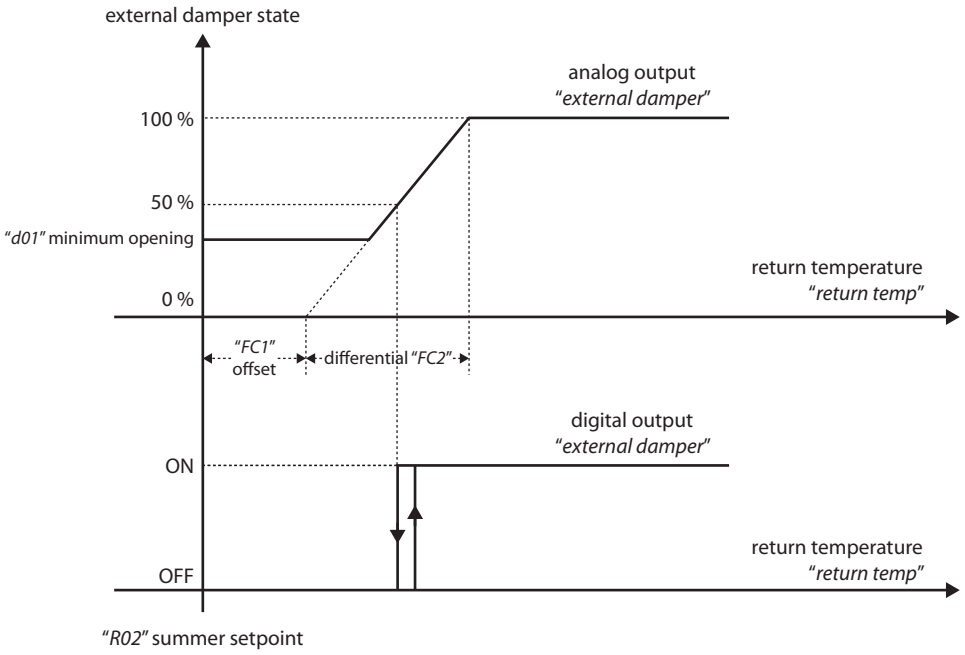


Fig 48 [External damper and free cooling - Summer free cooling]

The free cooling request decreases proportionally as the supply air temperature drops, (see 13.0 "Controlling the supply temperature limits").

It is then possible to establish a time "*FC3*" during which the cooling units are not activated, even if the control action were to request it. They are only activated if the request is still present when this time has elapsed.

This time is calculated from when the free cooling conditions are satisfied.

16.1.2 Winter free heating

As shown in the figure below, the opening of the external damper is controlled by the probe defined with "*FH5*" between the return air temperature "*REt - Return Temp" or the "OUt - Outdoor Air Temperature*" as long as the following conditions are met:

- the unit is running in winter mode
- the winter free heating function is enabled "*FH0=YES*"
- the outside air is hot enough vs. the room temperature, in other words if:
  outside temperature ("*OUt - Outdoor Temp*") > return temperature ("*REt - Return Temp*") + free heating delta "*FH4*".
  Free heating is disabled when outside temperature becomes lower than return temperature

The free heating differential "*FH2*" is used to define the damper modulation range.

An offset "*FH1*" is used to establish the position of the modulation band vs. the main temperature setpoint: damper setpoint=winter setpoint "*R03*" + offset "*FH1*".
With a negative offset, free heating is activated before the winter setpoint.

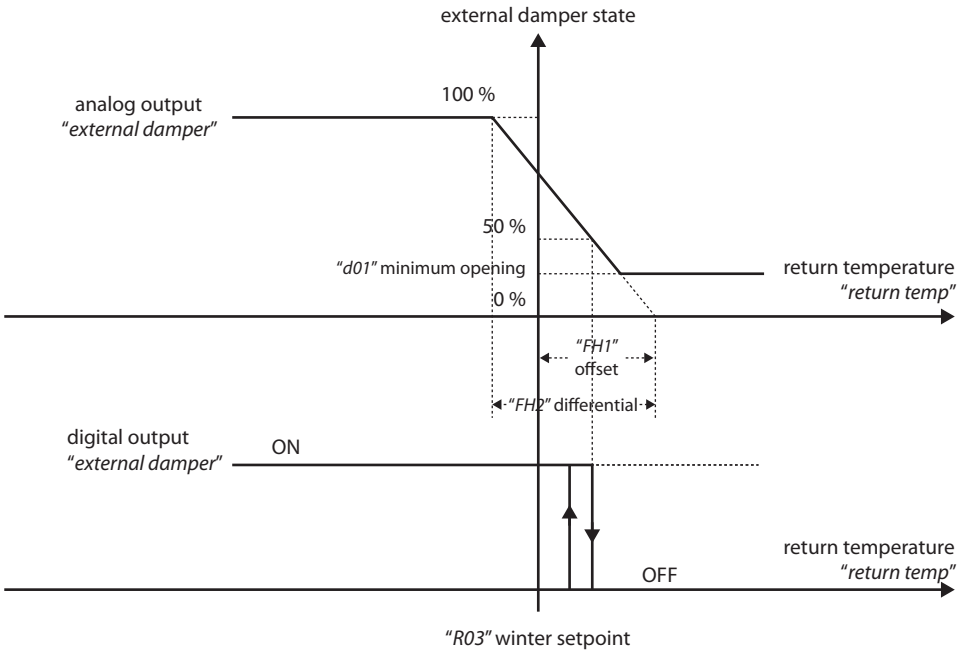


Fig 49 [External damper and free cooling - Winter free heating]

The free heating request decreases proportionally as the supply air temperature rises, (see 13.0 "Controlling the supply temperature limits").

It is then possible to establish a free heating-only time "*FH3*" during which the heating units are not activated, even if the control action were to request it. They are only activated if the request is still present.

16.1.3 Winter free cooling

Winter free cooling can be useful, for example, in shopping centres, as there may be times even in winter operation when cooling is needed instead of heating; in this case, cooling makes the most of the outside conditions.

As shown in the figure below, opening of the external damper is controlled by the probe defined with "*FH5*" between the return air temperature "*REt - Return Temp*" or the "*OUt - Outdoor Air Temperature*" as long as the following conditions are met:

- the unit is running in winter mode
- the winter free cooling function is enabled "*FW0=YES*"
- the outside air is cold enough vs. the room temperature, in other words if:
  outside temperature ("*OUt - Outdoor Temp*") < return temperature ("*REt - Return Temp*") - free cooling delta "*FW4*".
  Free cooling is disabled when the outside temperature becomes higher than the return temperature

The free cooling differential "*FW2*" is used to define the damper modulation range.

An offset "*FW1*" is used to establish the position of the modulation band vs. the main temperature setpoint:
damper setpoint=winter setpoint "*R03*" + offset "*FW1*".
With a positive offset, free cooling is activated after the summer setpoint.

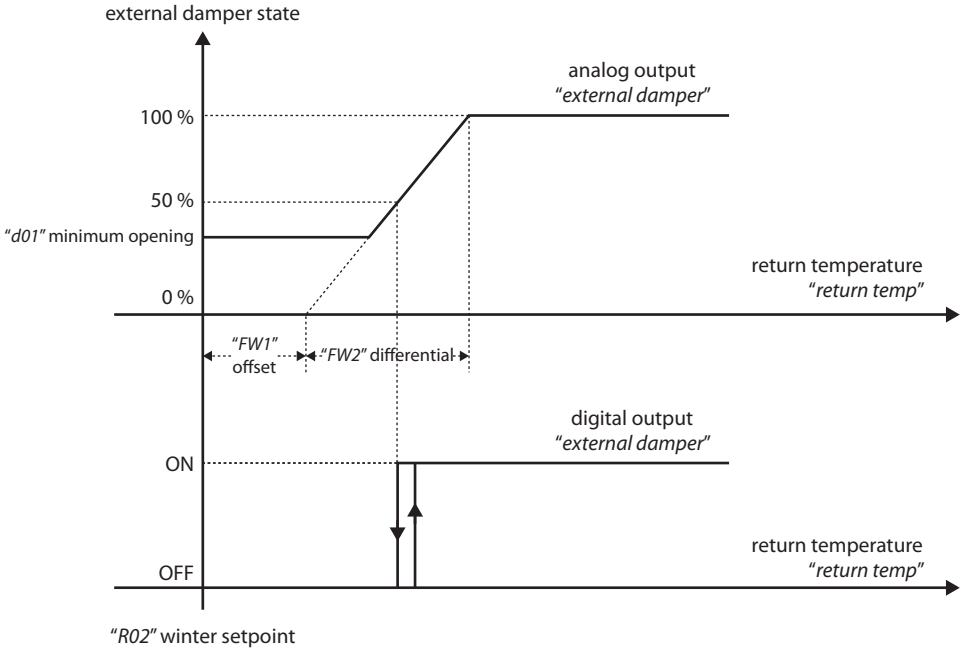


Fig 50 [External damper and free cooling - Winter free cooling]

The free cooling request decreases proportionally as the supply air temperature drops,
(see 13.0 "Controlling the supply temperature limits").

16.2 Enthalpy control "dE0=Enth"

Note

This function must be enabled from the "Functionalities" tab of the MCXShape configuration tool. Tick the "Enable enthalpy on damper regulation" check box.

To enable the enthalpy control, the following probes have to be present: Return Temperature, Return Humidity, Outdoor Temperature and Outdoor Humidity.
With the Parameter "*Ec4*" and "*Eh4*" it is possible to simulate the Outdoor Humidity probe, if it is not present.

In summer mode we refer to "*Free cooling on enthalpy*" and in winter mode "*Free heating on enthalpy*". The difference is in the references used.
In summer mode the parameter to set is one of the following:

- "*Ec1*" setpoint in summer
- "*Ec2*" bandwith in summer
- "*Ec3*" hysteresis in summer
- "*Ec4*" cool humidity simulation

In winter mode the parameter to set is one of the following:

- "*Eh1*" setpoint in winter
- "*Eh2*" bandwith in winter
- "*Eh3*" hysteresis in winter
- "*Eh4*" heat humidity simulation

As described in the figures below, enthalpy control is different depending on whether the external enthalpy is lower or higher than the enthalpy setpoint. In any case the outside air is used to move the internal enthalpy close to the setpoint by opening the external damper when possible.

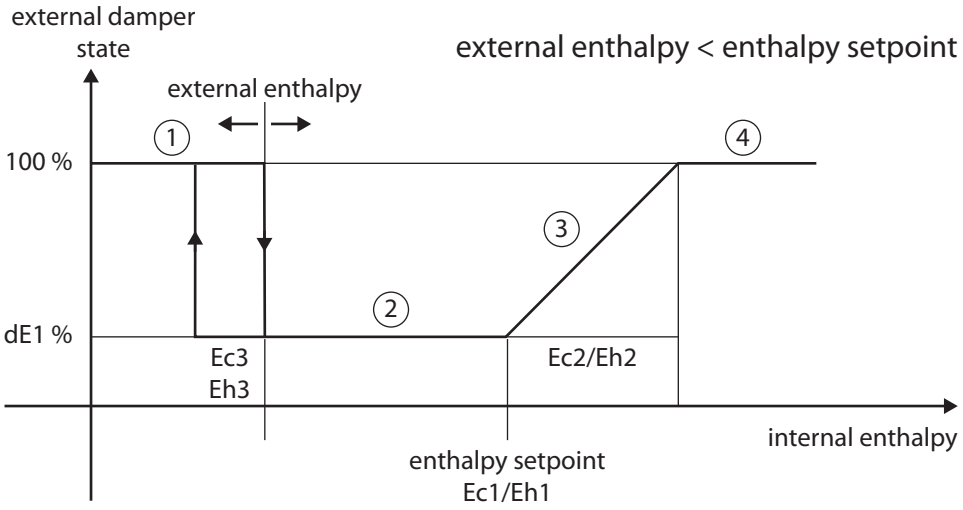


Fig 51 [External damper and free cooling - Enthalpy control 01]

When the external enthalpy is lower than the setpoint, if the internal enthalpy is lower than the setpoint but greater than the external enthalpy (2), opening the damper is is inconvenient and the external dumper is positioned to the "*dE1*" minimum opening.
If the internal enthalpy is below both the setpoint and the external enthalpy (1), the external dumper is opened. If the internal enthalpy is higher than the setpoint then the damper is modulated in the "*Ec2/Eh2*" band (3).

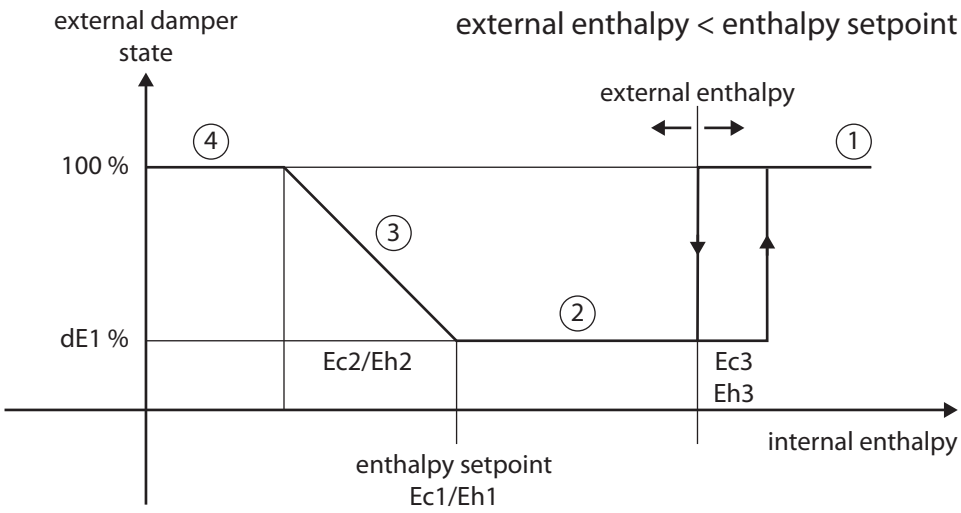


Fig 52 [External damper and free cooling - Enthalpy control 02]

When the external enthalpy is higher than the setpoint, if the internal enthalpy is higher than the setpoint but lower than the external enthalpy (2), opening the damper is not convenient and the external dumper is positioned to the "*dE1*" minimum opening.
If the internal enthalpy is above both the setpoint and the external enthalpy (1), the external dumper is opened.
If the internal enthalpy is lower than the setpoint then the damper is modulated in the "*Ec2/Eh2*" band (3).

16.3 Air quality control

Control of the air quality is performed according to the "*C02*" (carbon dioxide) and "*VOC*" (Volatile Organic Compound) probes connected to the analog inputs
"*CO2 - CO2*" and "*VOC - VOC*". Without these probes, it is still possible to achieve a timed air recirculation.

Whether requested by the "*VOC*" or "*CO2*" probes or set to be performed at certain intervals, air changeover has priority over damper management. This means that the outside air damper can be opened even if the outside temperature conditions are not favourable to free cooling/free heating.

If both probes, "*VOC*" and "*CO2*", are present, the damper is controlled by the higher of the two signals.
A setpoint for "*CO2*" control is defined in "*P03*" with its relative differential "*P04*" and a setpoint for the "*VOC*" control is defined in "*P05*" with its relative differential "*P06*".
The request to open the damper to control the air quality is added to the normal temperature control request.

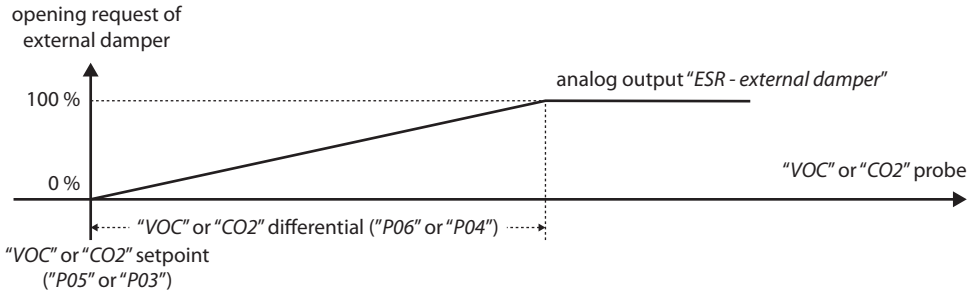


Fig 53 [External damper and free cooling - Air quality control]

If neither air quality measurement probe is not present and the parameter "*P01*" is something other than 0, the external damper is opened periodically for time "*P02*", the frequency of this opening is defined in "*P01*".

17.0 Energy recovery

The following types of recovery units are handled:

- dual coil
- rotary
- crossed flow

Activating energy recovery
To be able to recover the heat, the enabling parameter "*E00*" must be set to YES and the return temperature "*REt - Return Temp*" must be lower than the outside temperature "*OUt - Outdoor Temp*" in summer (cooling), and higher in winter (heating). The threshold for the difference between the return temperature and the outside temperature beyond which energy recovery is activated is the recovery setpoint "*E01*".

The parameter that controls energy recovery is therefore:

- Trecovery = Outdoor Temp – Return Temp, in summer
- Trecovery = Return Temp – Outdoor Temp, in winter

To enable/disable recovery, the "*E02*" hysteresis is applied.
Therefore:

- If Trecovery >= recovery setpoint "*E01*", recovery is enabled
- If Trecovery < recovery setpoint "*E01 - recovery differential*", "*E02*", recovery is disabled

17.1 Pumped glygol energy recovery

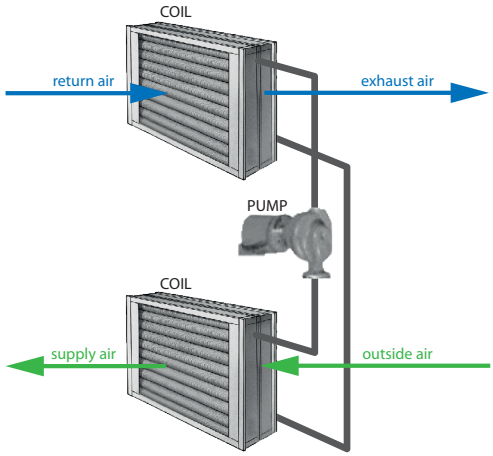


Fig 54 [Energy recovery - Pumped glygol energy recovery]

Operates on the intermediate fluid pump "*PRE - Recovery Pump*" as described in the figure.
In other words:

- pump ON if Trecovery >= recovery setpoint "*E01*"
- pump OFF if Trecovery < recovery setpoint "*E01 - recovery differential*", "*E02*"

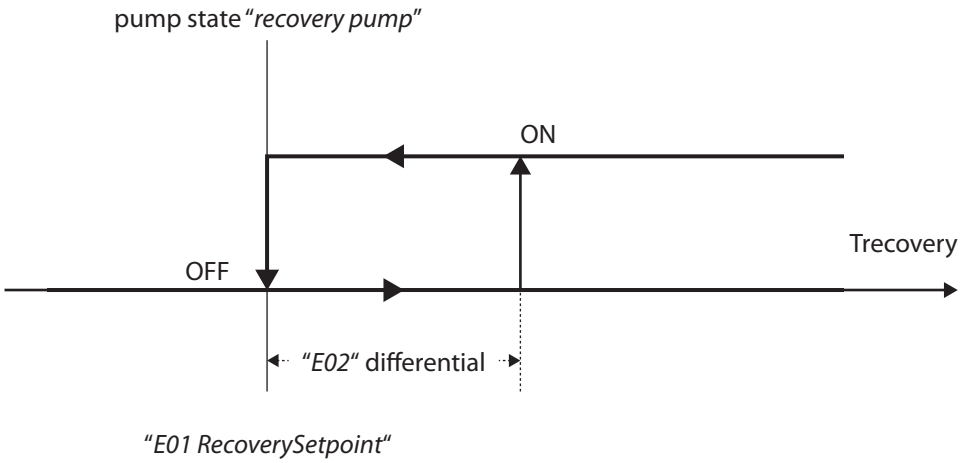


Fig 55 [Energy recovery - Dual coil energy recovery]

Forcing the pump
If the force pump function is enabled "*E03=YES*" and if the outside temperature "*OUt - Outdoor Temp*" drops below the threshold "*E04*" for an amount of time "*E06*", the recovery pump is forced ON even if the conditions for activating recovery are not met. Forcing is terminated when "*OUt - Outdoor Temp*" reaches "*E04*" + "*E05*" temperature.

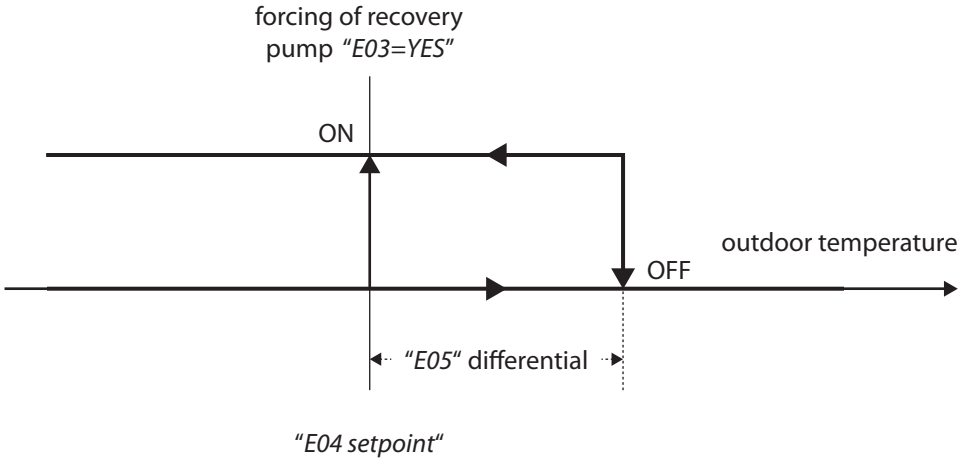


Fig 56 [Energy recovery - Forcing the pump]

17.2 Cross flow energy recovery

Energy recovery is activated by allowing the air to pass through the recovery unit.
Depending on the type of recovery unit, two cases can be seen.

1. Bypass damper on the recovery unit "*E07=NO*".
   A recovery unit bypass damper "*ARE - Recovery*" is managed and, if closed, it deviates the air, preventing it from passing through the recovery unit.
   The type of bypass damper can be ON/OFF or modulating

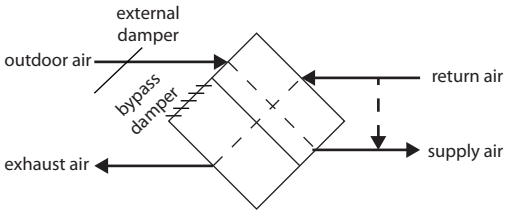


Fig 57 [Energy recovery - Bypass damper on the recovery unit 01]

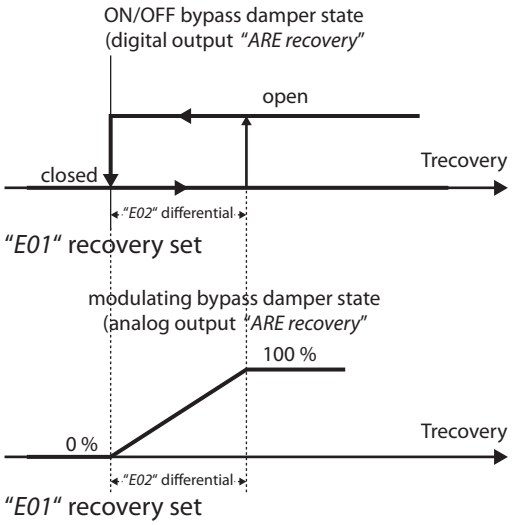


Fig 58 [Energy recovery - Bypass damper on the recovery unit 02]

2. Bypass damper outside the recovery unit "E07=YES"

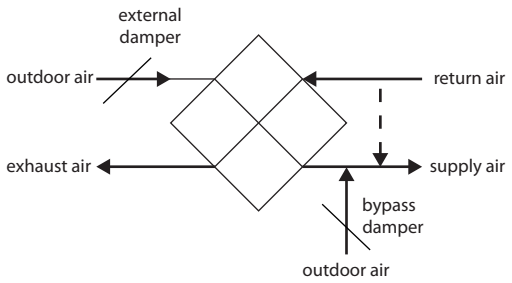


Fig 59 [Energy recovery - Bypass damper outside the recovery unit]

The bypass "*ARE - Recovery*" and outdoor air "*RSE - External Damper*" dampers are operated as follows:

- **Recovery ON** bypass damper closed and external damper as required by the control action. Free cooling/free heating is performed normally, modulating the external damper.
- **Recovery OFF** bypass damper as required by the control action (it takes the place of the external damper) and external damper closed. In this case, the free cooling/free heating is performed by modulating the bypass damper.

17.3 Energy recovery wheels

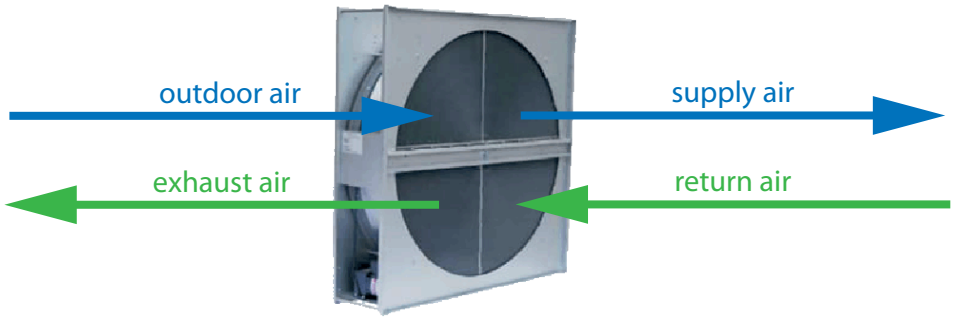


Fig 60 [Energy recovery wheels - Air]

This is operated by controlling the motor rotation speed and, if present, controlling the bypass damper.
To manage the damper, use the digital output "*ARE - Recovery*". If closed, it deviates the air, preventing it from passing through the recovery unit.
To control the motor rotation speed, use the analog output "*ARE - Recovery*", as described in the figure.

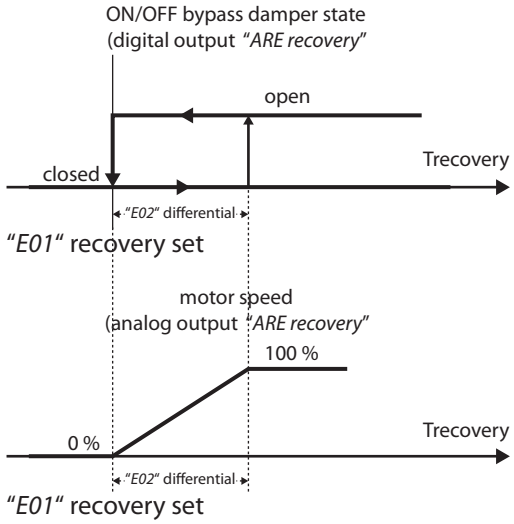


Fig 61 [Energy recovery wheels - Rotary energy recovery]

18.0 Alarms

18.1 Actions following an alarm

When an alarm occurs, the following actions are generally executed (according to what is defined through the "*mcxs configuration*" file):

- the buzzer sounds, if present and if envisaged by the specific alarm, (see 18.3 "Alarms table")
- the alarm relay "*ALA - Alarm*" or the warning "*WAR - Warning*" is activated depending on what is envisaged by the specific alarm, (see 18.3 "Alarms table").
  The MCXShape configuration tool can be used to define whether the alarm is activated when the unit is OFF.
  In the absence of an alarm condition, the Normally Closed (N.C.) and Normally Open (N.O.) state of the alarm relay is defined when the physical output is configured.
  If the polarity is "*Open*" (default setting), the relay is powered in case of an alarm
- the alarm icon is displayed along with the code for the alarm and its description (only for units with LCD display).
  For a complete description of the user interface in the case of alarms, (see 2.0 "User interface")

18.2 Types of reset

Through the MCXShape configuration tool it is possible to set how the alarms are to be reset: manually, automatically or semi-automatically:

- **manual** — a specific procedure is required to reset the alarm if the alarm condition no longer exists:
  from the menu (Menu: ALA – Alarms, Sub-menu: RAL – Reset Alarms) or by pressing and holding the key for three seconds from within the alarms display screen to reset all the alarms, (see 2.0 "User interface")
- **automatic** — the alarm is deactivated and the signal disappears as soon as the alarm conditions cease
- **semi-automatic** — this means that reset reverts from automatic to manual after it has occurred a certain (configurable through MCXShape configuration tool) number of times

The buzzer is silenced the first time any button is pressed, even if the alarm condition remains inactive; it will remain muted until a new alarm occurs.

18.3 Alarms table

As described in the table below each alarm is characterised by:

- code: ID tag that unequivocally identifies the alarm and which is displayed on the screen
- description: displayed only on LCD displays
- source of the alarm
- type of reset: (-1=automatic, 0=manual, >0=number of occurrences for semi-automatic alarms)
- if semi-automatic alarms, the period for counting alarm occurrences; if during this time the alarm exceeds its maximum number of occurrences, it becomes a manual reset alarm
- delays for detecting the alarm after start-up and when in steady operation
- whether it is active even when the machine is in standby mode
- how it affects the alarm relay, warning and buzzer
- how it affects the unit actuators

Cod	Description	Source	Type of reset	Delay at start-up	Oper. delay	Active with unit OFF	Alarm relay	Warn. relay	Buzzer	Actuators OFF
A01	Supply fan alarm	Digital input "SupFan Alarm"	-1 (automatic)	0	0	NO	YES	NO	YES	All
A02	Damper locked	Digital input "*SupDamp Closed*" and output "*Supply Damper*" active or Digital input "*ExtDamp Closed*" and output "*External Damper*" active	-1 (automatic)	0	3	NO	YES	NO	YES	No one
A03	Supply fan safety switch	Digital input "*SupFan SafeSW*"	-1 (automatic)	0	0	NO	YES	NO	YES	All
A07	Anti frost alarm "*C1*"	Digital input "*Freeze Alarm*" or Analog input (defined in "*IC1<=IC2*")	-1 (automatic)	0	0	YES	YES	NO	YES	Involved actuators
A21	Anti frost alarm "*C2*"	Digital input "*Freeze Alarm*" or Analog input (defined in "*IC1<=IC2*")	-1 (automatic)	0	0	YES	YES	NO	YES	
A08	Fire alarm	Digital input "*Fire Alarm*"	-1 (automatic)	0	0	YES	YES	NO	YES	All
A09	Supply air flow alarm	Digital input "*Supply Flow*"	-1 (automatic)	5	5	NO	NO	YES	YES	System
A11	Supply filter alarm	Digital input "*Supply Filter*"	-1 (automatic)	0	0	NO	NO	YES	YES	System
A14	Heating pump overload	Digital input "*Heating Pump*"	-1 (automatic)	0	0	NO	YES	YES	YES	No one
A18	Humidifier alarm	Digital input "*HumidifierAlarm*"	-1 (automatic)	0	0	NO	YES	YES	YES	No one
A19	Recovery alarm	Digital input "*RecoveryAlarm*"	-1 (automatic)	0	0	NO	YES	YES	YES	No one
A20	General alarm	Digital input "*General Alarm*"	-1 (automatic)	0	0	NO	YES	YES	YES	No one
CN	No connection with EXC Module	Communication error with EXC extension	-1 (automatic)	30	5	NO	YES	YES	YES	No one
e01	Supply temp. probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	YES	NO	NO	No one
e02	Return temp. probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	YES	NO	NO	Involved actuators
e03	Outdoor probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	YES	NO	NO	System
e04	Anti Frost "*C1*" probe error	Probe open or short circuited	-1 (automatic)	20	10	YES	YES	NO	YES	All
e05	AntiFrost "*C2*" probe error	Probe open or short circuited	-1 (automatic)	20	10	YES	YES	NO	YES	All

Cod	Description	Source	Type of reset	Delay at start-up	Oper. delay	Active with unit OFF	Alarm relay	Warn. relay	Buzzer	Actuators OFF
e06	Air Pressure probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e07	Sup.Humidity probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e08	Ret.Humidity probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e09	"*CO2*" probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e10	VOC probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e11	Condenser 1 probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	YES	NO	YES	Involved actuators
e12	Condenser 2 probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	YES	NO	YES	Involved actuators
e13	Remote Set probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e14	Outdoor Humidity probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e15	Suction Press "*C1*" probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e16	Suction Press "*C2*" probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e17	Suction Temperature C1 probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e18	Suction Temperature C2 probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e19	Discharge Temperature C1 probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e20	Discharge Temperature C2 probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
e21	Ambient probe error	Probe open or short circuited	-1 (automatic)	20	10	NO	NO	NO	NO	No one
ACG	General compressors	Digital Input "*CompGenAlarm*"	0 (manuale)	0	0	NO	YES	NO	YES	Compressor

Cod	Description	Source	Type of reset	Delay at start-up	Oper. delay	Active with unit OFF	Alarm relay	Warn. relay	Buzzer	Actuators OFF
AC1	Compressor 1	Digital Input "Comp1 Alarm"	-1 (automatic)	0	0	NO	YES	NO	YES	Compressor 1
AC2	Compressor 2	Digital Input "*Comp2 Alarm*"	-1 (automatic)	0	0	NO	YES	NO	YES	Compressor 2
AC3	Compressor 3	Digital Input "*Comp3 Alarm*"	-1 (automatic)	0	0	NO	YES	NO	YES	Compressor 3
AC4	Compressor 4	Digital Input "*Comp4 Alarm*"	-1 (automatic)	0	0	NO	YES	NO	YES	Compressor 4
AG1	General condenser 1	Digital Input "*Cond1GenAlarm*"	-1 (automatic)	0	0	NO	YES	NO	YES	Condenser 1
AF1	Condenser 1 Stage 1	Digital Input "*Cond1 Stage1*"	-1 (automatic)	0	0	NO	YES	NO	YES	Condenser 1 Stage 1
AF2	Condenser 1 Stage 2	Digital Input "*Cond1 Stage2*"	-1 (automatic)	0	0	NO	YES	NO	YES	Condenser 1 Stage 2
AF3	Condenser 1 Stage 3	Digital Input "*Cond1 Stage3*"	-1 (automatic)	0	0	NO	YES	NO	YES	Condenser 1 Stage 3
AG2	General condenser 2	Digital Input "*Cond2GenAlarm*"	-1 (automatic)	0	0	NO	YES	NO	YES	Generale Condenser 2
AF4	Condenser 2 Stage 1	Digital Input "*Cond2 Stage1*"	-1 (automatic)	0	0	NO	YES	NO	YES	Condenser 2 Stage 1
AF5	Condenser 2 Stage 2	Digital Input "*Cond2 Stage2*"	-1 (automatic)	0	0	NO	YES	NO	YES	Condenser 2 Stage 2
AF6	Condenser 2 Stage 3	Digital Input "*Cond2 Stage3*"	-1 (automatic)	0	0	NO	YES	NO	YES	Condenser 2 Stage 3
AHP	High pressure circuit 1	Digital Input "*HighPressure1*" or Analog Input "*Condenser1 >= APH*"	-1 (automatic)	0	0	NO	YES	NO	YES	Compressors OFF and Fan ON Circuit 1
ALP	Low pressure circuit 1	Digital Input "*LowPressure1*"	-1 (automatic)	5	30	NO	YES	NO	YES	Compressors Circuit 1
AH2	High pressure circuit 2	Digital Input "*HighPressure2*" or Analog Input "*Condenser2 >= APH*"	-1 (automatic)	0	0	NO	YES	NO	YES	Compressors OFF and Fan ON Circuit 2
AL2	Low pressure circuit 2	Digital Input "*LowPressure2*"	-1 (automatic)	5	30	NO	YES	NO	YES	Compressors Circuit 2
ARG	General heating	Digital Input "*HeaterGenAlarm*"	-1 (automatic)	0	0	NO	YES	NO	YES	Heating
AR1	Heater 1	Digital Input "*Heater1 Alarm*"	-1 (automatic)	0	0	NO	YES	NO	YES	Heater 1
AR2	Heater 2	Digital Input "*Heater2 Alarm*"	-1 (automatic)	0	0	NO	YES	NO	YES	Heater 2
AR3	Heater 3	Digital Input "*Heater3 Alarm*"	-1 (automatic)	0	0	NO	YES	NO	YES	Heater 3

Cod	Description	Source	Type of reset	Delay at start-up	Oper. delay	Active with unit OFF	Alarm relay	Warn. relay	Buzzer	Actuators OFF
AR4	Heater 4	Digital Input "*Heater4 Alarm*"	-1 (automatic)	0	0	NO	YES	NO	YES	Heater 4
DTE	Long defrost	Defrost duration >= "*d15*"	-1 (automatic)	0	0	NO	NO	YES	YES	Stop defrost
W01	Service compressor 1	Operation hours >= "*W01*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W02	Service compressor 2	Operation hours >= "*W02*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W03	Service compressor 3	Operation hours >= "*W03*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W04	Service compressor 4	Operation hours >= "*W04*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W05	Service condenser 1 stage 1	Operation hours >= "*W05*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W06	Service condenser 1 stage 2	Operation hours >= "*W06*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W07	Service condenser 1 stage 3	Operation hours >= "*W07*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W08	Service condenser 2 stage 1	Operation hours >= "*W08*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W09	Service condenser 2 stage 2	Operation hours >= "*W09*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W10	Service condenser 2 stage 3	Operation hours >= "*W10*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W11	Service fan	Operation hours >= "*W11*"	-1 (automatic)	0	0	NO	NO	YES	NO	No one
W12	Compressor Cold Oil Prevention	Waiting time for oil warm up	-1 (automatic)	0	0	YES	NO	YES	NO	No one
E10	EEV1 Connection	EXD CANbus communication	-1 (automatic)	20	15	NO	YES	NO	NO	No one
E11	EEV1 Power fail closure	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one
E12	EEV1 S2 Error	EXD CANbus comm.	0 (manual)	20	15	NO	YES	NO	NO	No one
E13	EEV1 S4 Error	EXD CANbus comm.	0 (manual)	20	15	NO	YES	NO	NO	No one
E14	EEV1 Pe error	EXD CANbus comm.	0 (manual)	20	15	NO	YES	NO	NO	No one
E15	EEV1 Ext Ref. Error	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one

Cod	Description	Source	Type of reset	Delay at start-up	Oper. delay	Active with unit OFF	Alarm relay	Warn. relay	Buzzer	Actuators OFF
E16	EEV1 NO Refrg. Selected	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one
E17	EEV1 Valve Error	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one
E18	EEV1 Battery low	EXD CANbus communication.	0 (manual)	20	15	NO	YES	NO	NO	No one
E19	EEV1 driver error	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one
E20	EEV2 Connection	EXD CANbus communication	-1 (automatic)	20	15	NO	YES	NO	NO	No one
E21	EEV2 Power fail closure	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one
E22	EEV2 S2 Error	EXD CANbus comm.	0 (manual)	20	15	NO	YES	NO	NO	No one
E23	EEV2 S4 Error	EXD CANbus comm.	0 (manual)	20	15	NO	YES	NO	NO	No one
E24	EEV2 Pe error	EXD CANbus comm.	0 (manual)	20	15	NO	YES	NO	NO	No one
E25	EEV2 Ext Ref. Error	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one
E26	EEV2 NO Refrg. Selected	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one
E27	EEV2 Valve Error	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one
E28	EEV2 Battery low	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one
E29	EEV2 driver error	EXD CANbus communication	0 (manual)	20	15	NO	YES	NO	NO	No one
GA1	Aux Alarm 1	Digital Input "*Aux alarm 1*" or Alarm Probe 1 >= a11	-1 (Automatic)	0	0	NO	NO	NO	NO	(See "*mcxs configuration*" file)
GA2	Aux Alarm 2	Digital Input "*Aux alarm 2*" or Alarm Probe 2 >= a21	-1 (Automatic)	0	0	NO	NO	NO	NO	(See "*mcxs configuration*" file)
GA3	Aux Alarm 3	Digital Input "*Aux alarm 3*" or Alarm Probe 3 >= a31	-1 (Automatic)	0	0	NO	NO	NO	NO	(See "*mcxs configuration*" file)
GA4	Aux Alarm 4	Digital Input "*Aux alarm 4*" or Alarm Probe 4 >= a41	-1 (Automatic)	0	0	NO	NO	NO	NO	(See "*mcxs configuration*" file)
Ovt	Manual output override	Hardware output overwritten	-1 (Automatic)	0	0	NO	NO	NO	NO	No one

Tab 7 [Alarms - Alarms table]

18.4 Freeze blockage

Antifreeze is controlled by the thermostat (digital input "*AAI - Freeze Alarm*") or by the probe defined in "*IC1*", either the antifreeze probe "*IC1=tC2*" or the outdoor probe "*IC1=OUt*". If a probe is used, it is also necessary to define a setpoint "*IC2*" beyond which the alarm is activated and a differential "*IC3*" for the alarm reset.

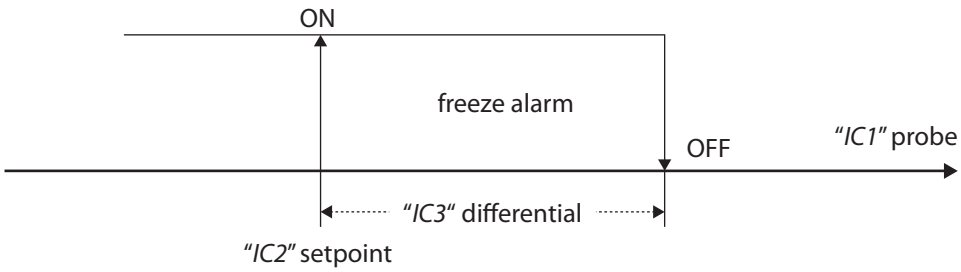


Fig 62 [Alarms - Freeze blockage]

In case of freeze alarm the following actions are taken:

- external damper is immediately closed
- maximum heat production
- maximum energy recovery
- humidification OFF

18.5 Damper locked

The supply or external damper locked alarm "*A02*" indicates that the digital input used to monitor damper opening "*CSS - SupDamp Closed*" or "*CSE - ExtDamp Closed*" signals that the damper is closed and, at the same time, the damper control signal "*SSH - Supply Damper*" or "*ESH - External Damper*" is active for at least three seconds.

18.6 Auxiliary alarms

Auxiliary digital inputs and auxiliary analogue inputs can be assigned. They can be used to activate alarms and relays. Text descriptions and alarm texts can be customised.

18.6.1 Auxiliary digital inputs

Digital auxiliary inputs can set an alarm and control a relay based on the alarm condition. This means that the alarm can be delayed as specified in the setup for individual alarms. Auxiliary alarm relay is activated after alarm delays have expired. The alarm can affect the alarm relays and alarm events. Up to four digital auxiliary alarm inputs with corresponding alarm relay can be defined.

The following steps are required to set-up an alarm input:

1. Define a digital input "*Aux alarm 1" to "Aux alarm 4*", define polarity for the input. Input name can be modified. (MCXShape configuration tool tab "Digital Input")
2. Define the appropriate alarm definitions for "*Aux alarm 1*" to "*Aux alarm 4*" (MCXShape configuration tool tab "Alarms") - alarm texts can be modified
3. Optional: define an alarm relay output "*Aux alarm 1 on*" to "*Aux alarm 4 on*". Define corresponding polarity for the relay. (MCXShape configuration tool tab "Digital Output")
4. Optional: define the action of the alarm on the elements of the unit (MCXShape configuration tool tab "Alarms")

18.6.2 Auxiliary analog inputs

Analogue auxiliary inputs can set an alarm and control a relay based on signal levels. The alarm can be delayed as specified in the setup for individual alarms. The auxiliary alarm relay is activated after alarm delays have expired. The alarm can affect the alarm relays and alarm events.
Up to four auxiliary analogue inputs with corresponding alarm and relay can be defined.

The following steps are required to set-up an input:

1. Define an analogue input "*Auxiliary input 1*" to "*Auxiliary input 4*", define Type, Function, Min, Max, and Decimals
2. Define the appropriate alarm definitions for "*Aux alarm 1*" to "*Aux alarm 4*" (MCXShape configuration tool tab "Alarms") - alarm texts can be modified
3. Define a relay output "*Aux Alarm 1 on*" to "*Aux Alarm 4 on*". Define corresponding polarity for the relay. (MCXShape configuration tool tab "Digital Output")
4. The following parameters are needed to define alarm activation and relay activation

Code	Auxiliary inputs 1	Meaning
a11	Aux alarm 1 cut-in	signal level for activating the digital output "*Aux alarm 1 on*"
a12	Aux alarm 1 cut-out	signal level for deactivating the digital output "*Aux alarm 1 on*"
a21	Aux alarm 2 cut-in	signal level for activating the digital output "*Aux alarm 2 on*"
a22	Aux alarm 2 cut-out	signal level for deactivating the digital output "*Aux alarm 2 on*"
a31	Aux alarm 3 cut-in	signal level for activating the digital output "*Aux alarm 3 on*"
a32	Aux alarm 3 cut-out	signal level for deactivating the digital output "*Aux alarm 3 on*"
a41	Aux alarm 4 cut-in	signal level for activating the digital output "*Aux alarm 4 on*"
a42	Aux alarm 4 cut-out	signal level for deactivating the digital output "*Aux alarm 4 on*"

Tab 8 [Alarms - Auxiliary analog inputs]

19.0 Parameters

Parameters are divided into groups and subgroups according to the type of function performed. The parameters' characteristics described below can be defined by numerical values or they can depend on the value of another parameter.
All the characteristics can be modified through the MCXShape configuration tool and the "*mcxs configuration*" file, (see "MCXShape user manual").

Label: Unequivocally identifies the parameter

Description: describes the parameter's function

Min: lowest possible value

Max: highest possible value

Value: default factory value

Unit: unit of measurement

Decimals: number of decimal points

Level: parameters are organised into four levels. Levels 1 to 3 are associated with a password. It is not possible to access parameters of a level higher than the access level; on the other hand, it is possible to view parameters belonging to levels lower than or equal to the access level:

- level 0 can be accessed without a password
- level 1, easy access, groups together the parameter which are not critical for machine function and which are frequently modified
- level 2 groups together all parameters which are useful during machine installation
- level 3 groups together all critical parameters (typically reserved to the manufacturer)

Enabled: a non-enabled parameter is a parameter that cannot be modified (constant with default value); it does not appear on the user interface

Mode: indicates whether the parameter is in read only mode (Read) in read-write mode (R/W) or other (write mode only when the unit is on OFF)

Visibility: specifies whether parameter's visibility is a function of the value assumed by another parameter

Text values: list of mnemonic values that can be assumed by the parameter

The parameter's display and modification mode is accessed from the Menu.
For a complete description of the user interface, (see 2.0 "User interface").

19.1 Parameters table

For the complete list of parameters, (see the "*mcxs configuration*" file), included in the application software pack.

20.0 Modbus communication

The communication protocol supported on the RS485 network is the Modbus RTU slave.
Possible communications settings are the following:

CId - Serial address (CAN)
Serial node address, valid for the CAN network. Each node on the network must have an unequivocal address.

SEr - Serial address (Modbus)
Serial node address, valid for the Modbus network. Each node on the network must have an unequivocal address.

bAU – Serial Baudrate (Modbus)
- "*bAU=0*" communication disabled
- "*bAU=12*" baudrate=1200 baud
- "*bAU=24*" baudrate=2400 baud
- "*bAU=48*" baudrate=4800 baud
- "*bAU=96*" baudrate=9600 baud
- "*bAU=144*" baudrate=1440 baud
- "*bAU=192*" baudrate=19200 baud (default value)
- "*bAU=288*" baudrate=28800 baud
- "*bAU=384*" baudrate=38400 baud

COM – Serial settings
- "*COM=8N1*" 8 data bits, no parity, 1 stop bit
- "*COM=8E1*" 8 data bits, parity even, 1 stop bit
- "*COM=8N2*" 8 data bits, no parity, 2 stop bits

All exported variables are of the "*Holding Register*" type.

20.1 Table of exported variables

The table of the exported variable can be printed starting from the "*mcxs configuration*" file, using the MCXShape configuration tool, (see "MCXShape user manual").

Fig 63 [Modbus communication - Exported variable]

20.2 Input/output override from Modbus network

This function must be enabled from the "Functionalities" tab of the MCXShape configurator tool. Tick the "Enable Override of physical input and output".
Tick the "Enable remote override of input and output functions" if you want to override the function which has been associated to the physical input/output.
Refer to the document "MCX_IO_Override" for the list of Modbus variables which allows the input/output override.

21.0 Use of the MCXShape configuration tool

In order to define the available languages parameter's values, alarms and input/output configuration use the "*mcxs configuration*" file included in the software application pack,
(see "MCXShape user manual").

The Tool and application software pack are available for download at *www.danfoss.com/mcx*.
Registration required.

Image index

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